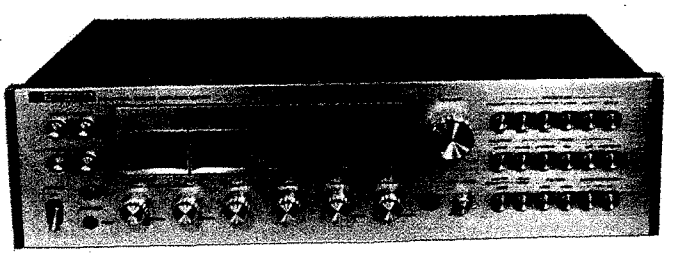
TOSHIBA 4 CHANNEL STEREO AMPLIFIER

SERVICE DATA

MODEL SB-514

FILE NO. 170-012



SPECIFICATIONS

Main Amplifier

Output:
IHF Music Power 180W (8Ω) BTL
(Distortion 0.2%)
Continuous 35W x 4 (8Ω)
Pomer (r.m.s) 70W x 2 (8Ω)BTL
(Distortion 0.2%)

Distortion Factor:
Total Harmonic Distortion Factor
At rating output (8Ω) 0.2%
IM Distortion Factor
At rating output (8Ω) 0.2%

Frequency Response: 10Hz - 70kHz +0, -1dB

Input Sensitivity and Impedance: MAIN IN 0.55V (47kΩ)

Residual Noise: 1.0mV (8Ω)

Damping Factor: 100 (8Ω)

Speaker Impedance: 4-16Ω (BTL 8-16Ω)

Pre-amplifier

Input Sensitivity and Impedance:

PHONO 1	CC	20mV (47kΩ)
PHONO 2	MAG	2mV (70kΩ)
PHONO 3		2mV (47kΩ)
TUNER		150mV (47kΩ)
AUX-1 (4CH)		150mV (47kΩ)
AUX-2 (4CH)		150mV (47kΩ)
4CH TAPE		150mV (47kΩ)

Recording Output:

TAPE REC	150mV
PRE OUT	0.5V (MAX 4.2V)

Frequency Response: 15Hz ~ 40kHz +1, -3dB

Total Harmonic Distortion Factor: At rating output 0.03%

Maximum Input Voltage:

PHONO MAG	240mV	(1kHz)
CC	1V	(1kHz)

Tone Control: BASS (100Hz) +10dB, -10dB
TREBLE (10kHz) +10dB, -10dB

Equalizer: RIAA Standard
+0.2dB, -0.2dB Curve

Signal-To-Noise Ratio:

PHONO MAG	(2mV)	65dB
CC	(30mV)	70dB
AUX	(150mV)	75dB

Power Source Voltage: AC 100/120/220/240V
50/60Hz

Power Consumption: 230W (At no signal 16W)

Transistors: 74 Transistors
38 Diodes

Dimensions:

W 450 (mm)	(17 23/32")
D 376	(14 13/16")
H 126	(5")

Weight: 11.5kg

TOKYO SHIBAURA ELECTRIC CO., LTD.

2-1, 5-CHOME, GINZA, CHUO-KU, TOKYO, JAPAN

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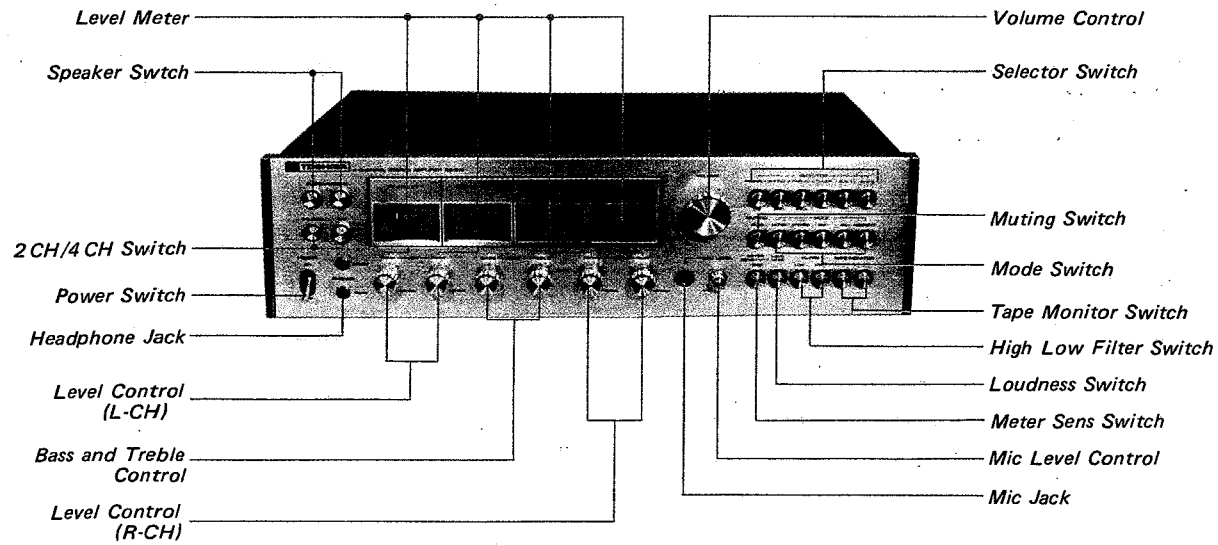
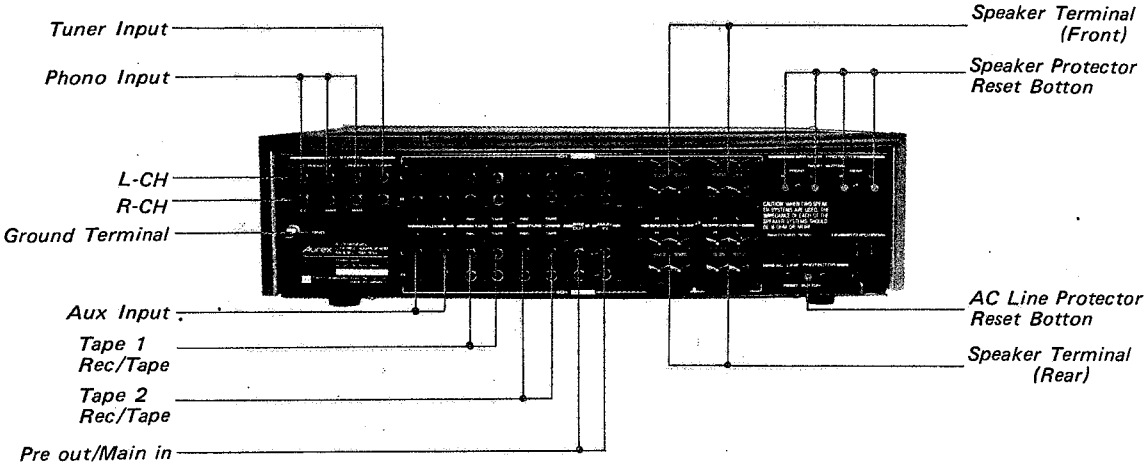
1. OPERATING CONTROLS

1-1. FRONT VIEW

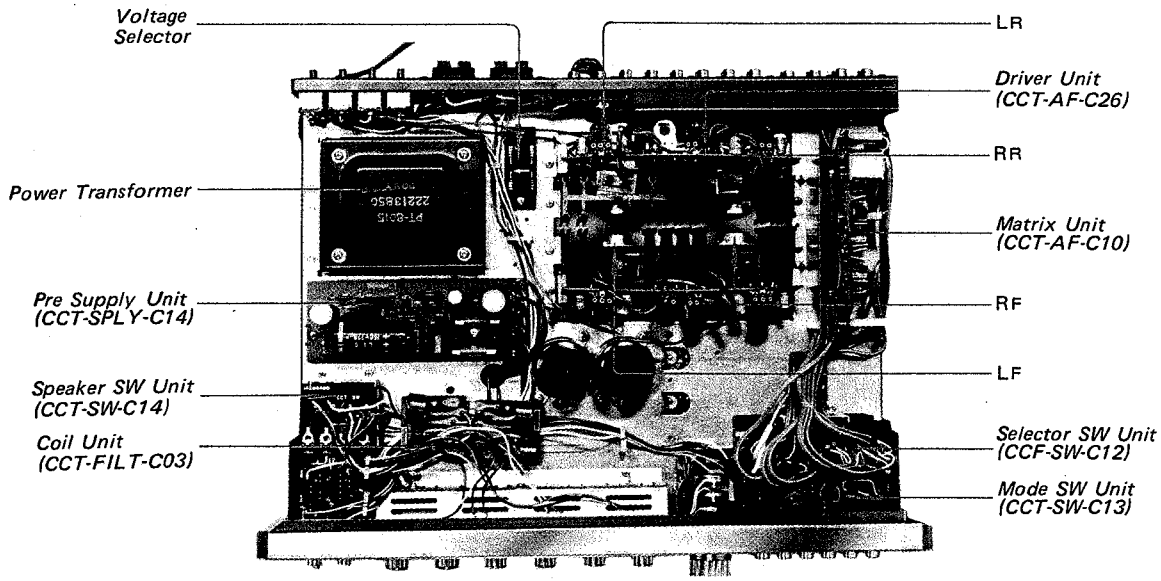


1-2. REAR VIEW

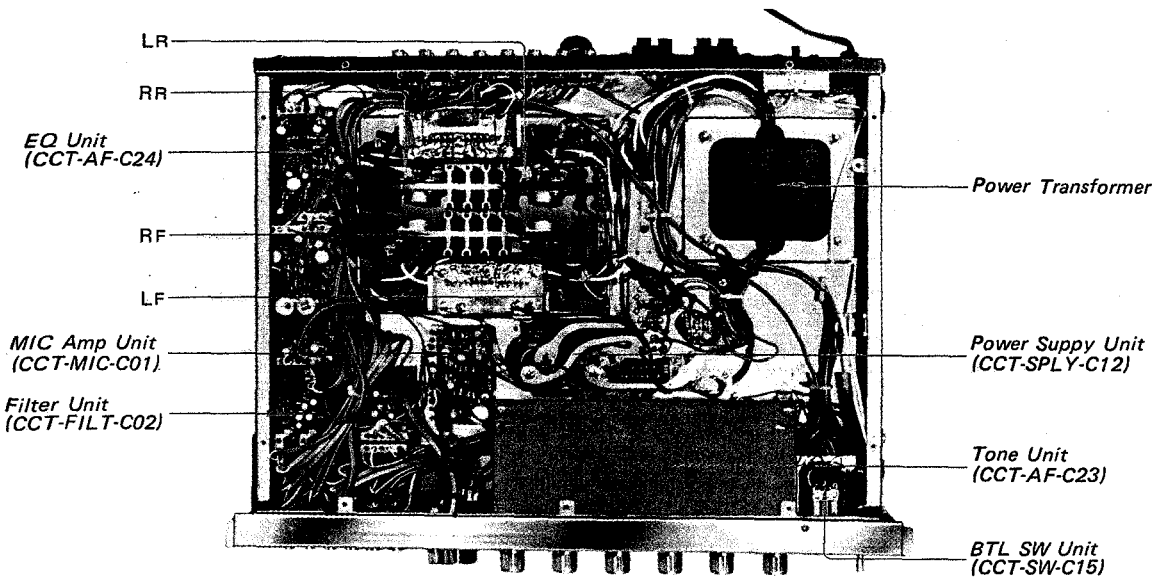


2. PARTS LOCATION

2-1. CHASSIS TOP VIEW

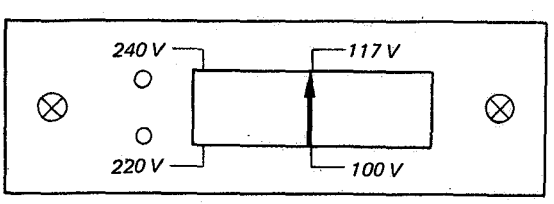


2-2. CHASSIS BOTTOM VIEW



3. VOLTAGE ADJUSTMENT

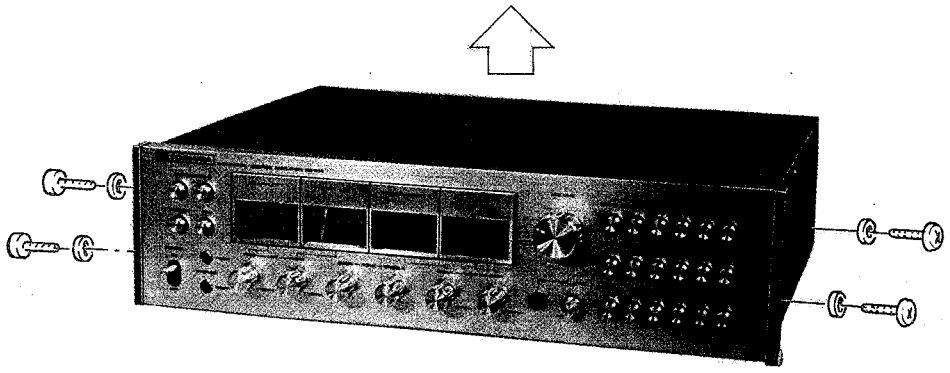
Insert the pin, adjusting the arrow in the direction of the power supply voltage applied.



4. DISASSEMBLY

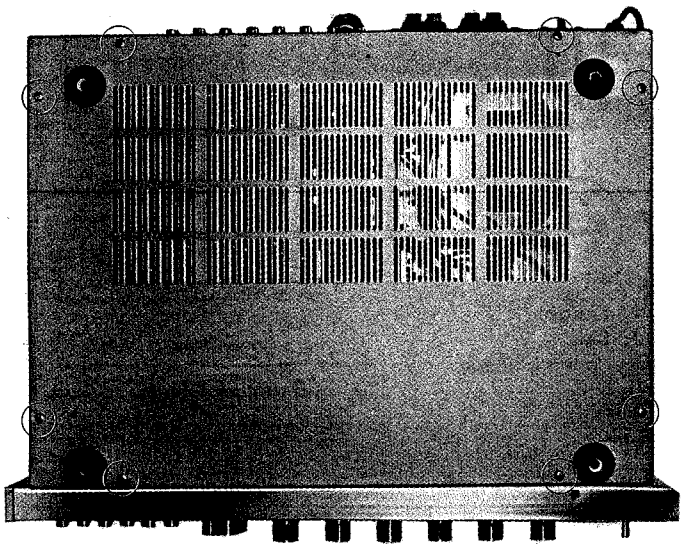
4-1. CABINET REMOVAL

1. Remove the four screws.
2. Remove the cabinet.

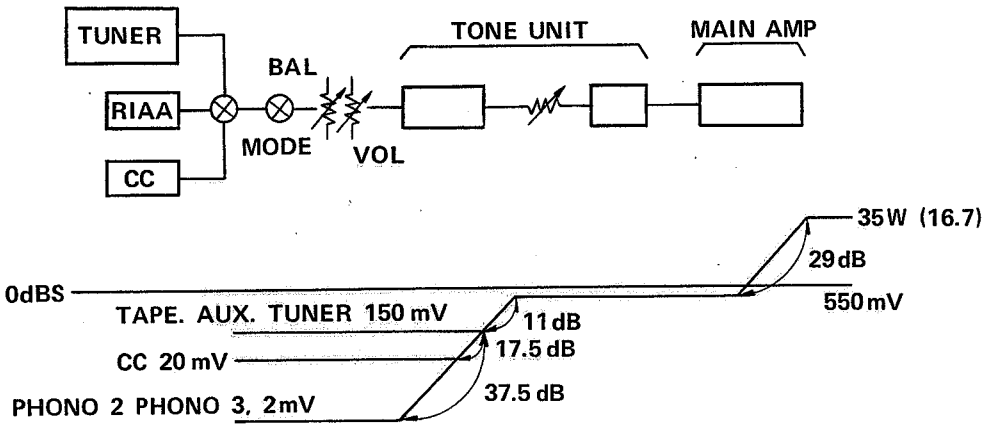


4-2. BACK COVER REMOVAL

1. Remove the eight screws.
2. Remove the back cover.

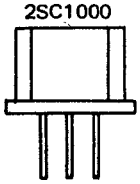


5. LEVEL DIAGRAM



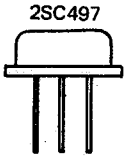
6. TRANSISTOR BASE DIAGRAMS

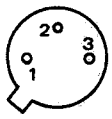
2SC1000



1. Emitter
2. Collector
3. Base

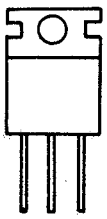
2SA497
2SC497

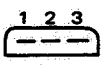




1. Emitter
2. Base
3. Collector (Case)

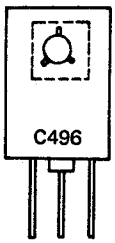
2SC1569

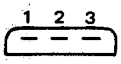




1. Base
2. Collector (Radiation Board)
3. Emitter

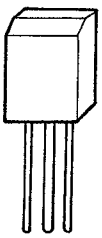
2SC496





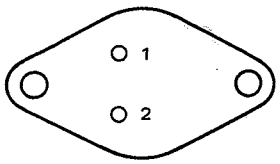
1. Emitter
2. Collector
3. Base

2SC983



1. Emitter
2. Collector
3. Base

2SC793
2SA663



1. Emitter
2. Base
3. Case Collector

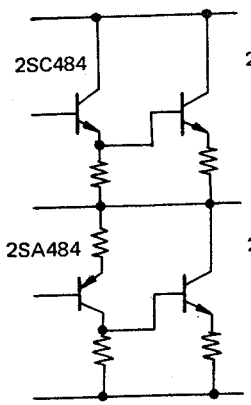
7. TECHNICAL POINTS

7-1. PURE COMPLEMENTARY CIRCUIT SYSTEM

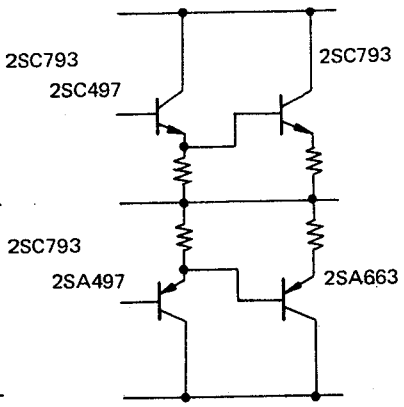
The difference between the Pure Complementary Circuit and the Quasi Complementary Circuit is that the Darlington connections in the lower part are, as shown in the figure below, connected to PNP-NPN for the Quasi Complementary Circuit and to PNP-PNP for the Pure Complementary Circuit. This difference results in the cross-over distortion in the unit. Although the switching distortion is inevitable with B class P-P amplifier, the Pure Complementary Circuit, where both upper and lower transistors are symmetrical each other, these distortions are canceled each other and the action similar to A class action is provided.

This can be afforded only with the newly developed PNP transistors, 2SA663, which are produced by the Toshiba's semiconductor manufacturing technology.

The distortion can be kept under 0.1% even with 10kHz at rated output and PBW is also greatly improved with the use of this transistor.



Quasi Complementary Circuit
(SA-20, SA-15)



Pure Complementary Circuit
(SB-514, SA-504)

7-2. DIRECT-COUPLING OUTPUT CAPACITOR LESS CIRCUIT SYSTEM

The following features are available by adopting the Output Capacitor Less of the direct-coupling two-power source system:

(1) Stable extension of frequency characteristic to the ultra low frequency range becomes possible.

(2) The output impedance (Damping Factor) does not vary even in the ultra low frequency range.

This feature together with the Pure Complementary Circuit system mentioned above is regarded as the one for the most ultimate and perfect amplifier today.

The most serious problems with the direct-coupling amplifier are the DC drift due to the temperature variation and the possibility of the occurrence of excess direct current to the speaker, which is caused by the transient shock at the moment of switching on the power supply and the unlikely break of the power transistors. In the model SB-514, these problems are resolved in such ways as follows: A differential amplifier consisting of the transistors of high current amplification factor, HFE, is incorporated in this unit in order to raise its DC stability. This shock at the moment of supply of power is reduced to some extent by inserting the twin-T type filter in the unit.

The speaker is safely protected against unlikely accident of transistor break by incorporating the circuit breaker between the speaker terminal and output circuit. On the contrary, in the case of shorting of the speaker terminal, the output circuit is protected by the circuit breaker built-in.

7-3. BUILT-IN SPECIAL AMPLIFIER FOR CONDENSER-CARTRIDGE

There are two types of cartridge, the velocity proportional type (MM, MC, etc.) and the amplitude proportional type (photoelectric cartridge, etc.).

The condenser-cartridge belongs to the latter type and a special correction curve different from the conventional one is necessary. The power for the ICs in the cartridge is supplied through the ground of the input terminal R channel. This amplifier can be directly connected with the condenser-cartridge (This is not the case for the photoelectric cartridge).

7-4. BTL CIRCUIT

When the four channel amplifier is used for reproduction with two speakers, this circuit is used in order to operate the four amplifiers effectively. The output voltage of two factors of magnitude can be supplied between the output terminals of each amplifier when the one speaker is operated in phase and the other out of phase with the use of the phase reverse circuit. Although the output power is theoretically of the four factors of magnitude from the relation, $(2V)^2/R = 4V^2/R$, that is in practice reduced to about two factors of magnitude due to losses such as the regulation of the transformer, the emitter resistance, etc.

7-5. MATRIX DECODER

All the two channel program sources (record, open reel, cassette, cartridge tape, FM broadcasting, etc.)

can be reproduced in the four channel fashion with the built-in MATRIX Decoder.

7-6. SQ

Fig. 1 shows signal components LT and RT recorded on SQ record disc. Decoder shown in Fig. 1-b changes composite two-channel signals into four-channel stereo signals FL, RL, FR and RR. Such a decoder produces sound field extended in right and left directions but not so extended in front and rear directions.

To improve front and rear channel separation, SQ decoder mixes LT and RT signals in proper proportion as shown in Fig. 2.

Note: *14 dB between front left and front right channels.
*6 dB between front and rear channels.
*6 dB between rear left and rear right channels.

Matrix circuits shown in Fig. 3-a, 3-b, 3-c and 3-d mixes LT + 0.2RT, RT + 0.2LT, LT - 0.4RT and RT - 0.4LT signals respectively. TR04, TR03, TR06 and TR05 amplifies signals attenuated by matrix circuits.

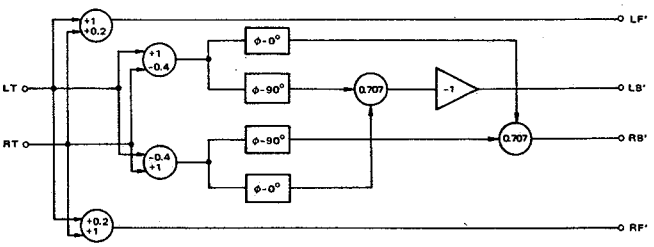
Circuit shown in Fig. 4-a has a phase characteristic in Fig. 4-b. Low Frequency signal output is almost the same phase as the input. As frequency becomes higher, output phase negatively shifts. Combination of such two circuits, one shifts 90 degrees at F1 and the other 90 degrees at F2, makes 90 degrees phase difference in some range. This circuit is called phase-shifter.

RL' and RR' signals are mixed through phase-shifter in Fig. 5-a and 5-b and amplified by TR09 and TR07 respectively to set the levels.

7-7. R-MTX

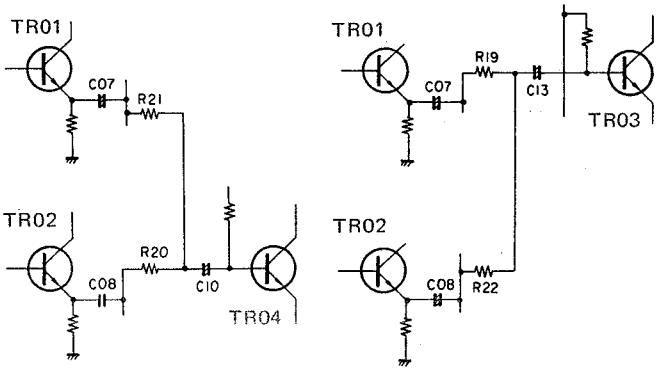
R-MTX circuit mixes front-left and front-right signals in the same proportion as SQ to improve front and rear channel separation.

Rear channel signals are mixed in the proportions such as RR = R - 0.4L and RL = L - 0.4R as shown in Fig. 6.



80° ~ 100° phase difference at approx. 100 ~ 760 Hz

Fig. 2



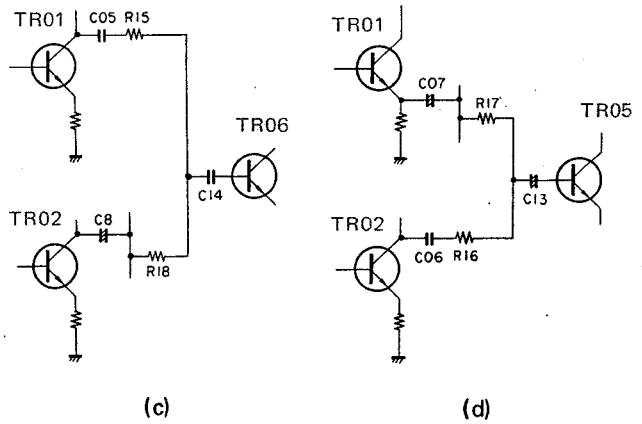


Fig. 3

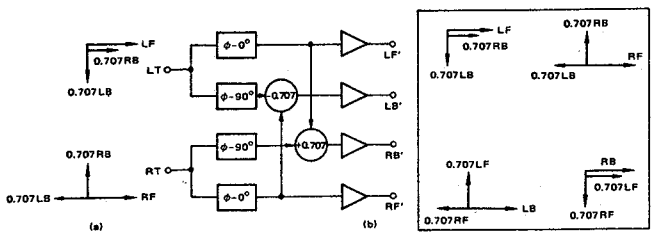


Fig. 1

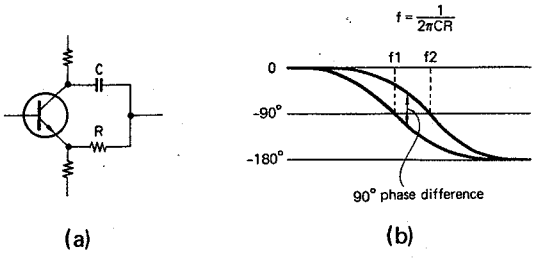
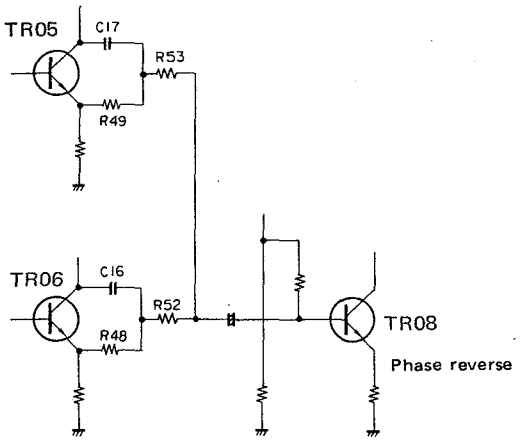
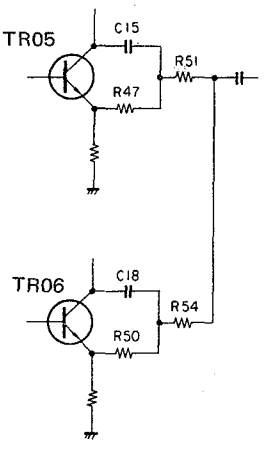


Fig. 4



(a)



(b)

Fig. 5

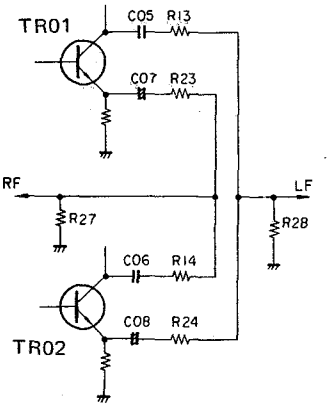


Fig. 6

8. SERVICE POINTS

ADJUSTING METHOD OF LEVEL METER SENSITIVITY

No.	Connection/Adjustment	Remarks
1.	Connect load resistance (8Ω, 50W) to speaker terminal (each channel).	
2.	Connect voltmeter in parallel to load resistance.	
3.	Set speaker switch to 4 CH.	
4.	Connect frequency oscillator to AUX-1 (4CH) of input terminal.	Keep frequency to 1 kHz.
5.	Set selector switch to AUX-1 (4CH) and mode switch to DISCRETE.	Turn volume and level controls fully clockwise and set bass and treble controls to mid-position.
6.	Put power supply switch on.	Set METER SENSITIVITY
7.	Increase input power until 15 V is indicated on the voltmeter and then adjust VR01 (VR02, VR03, VR04) until 0 dB is indicated on the voltmeter etc. (VR01, VR02, VR03, VR04) are semi-fixed resistor on SPEAKERS SW PCB.	Switch to −10 dB.

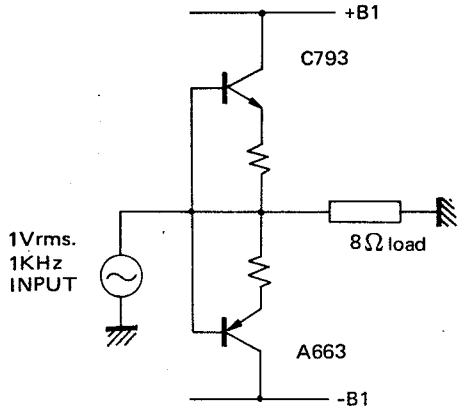
9. TROUBLE SHOOTING HINTS

How to examine the output power transistors:

Step 1. Remove the driver unit (AF-C04) from the connector. Also TR13 and TR14 (2SC496) are to be removed.

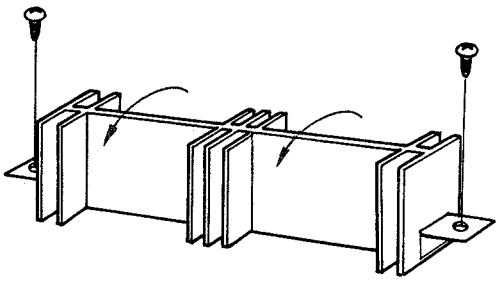
Step 2. Measure the voltage at the speaker output terminal or terminals 13 & 14 using a tester, with the power switch on.
OV (± 0.3V) indication is normal.

Step 3. Waveforms observation. Normal waveform illustrated below.

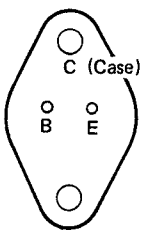


Replacement of defective power transistors:

Step 1. Remove the self-tap screws on both sides of the transistor and incline it forward as illustrated below.



Step 2. Remove the mounting screws securing the collector of the power transistor and pull out the transistor. (This is easily replaceable because TR socket is in use.)



How to examine the drive unit:

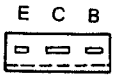
Note: If it is likely to break the power transistors during examination, disconnect the leads to the bases of 2SC793 and 2SA663.

Can one get correct mid-voltage?

Step 1. If OK ..... Does the voltage between the collector and the emitter of TR13 or TR14 (2SC496) change with variation of VR03 or VR04 (500 ohm)? (1.9V-3.5V)

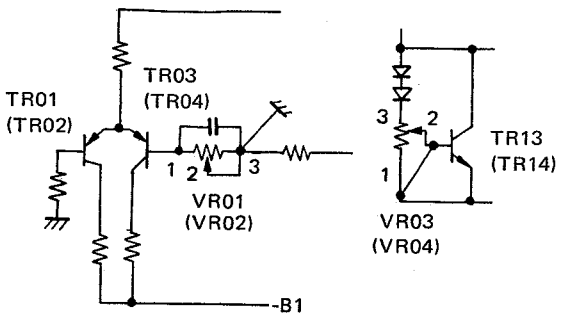
Step 2. OK ..... Normal
Adjust IC idle by VR03, VR04 with power transistors connected.
NO ..... 2SC496 is defective.

Step 3. If NOT .... If perfect adjustment to zero voltage is not possible (normally this is variable to both + and −, but in this case it is impossible), this is due to the rank difference between h_{FE}s of TR01/03 or TR02/04. Adjust the rank.



Check if the correct mid-voltage is obtainable or not.

Step 4. Examine TR, removing TR09 and TR11 (TR10 and TR12).
(Note) In many cases one meets troubles with TR09 and TR11.



Step 5. As shown above, connect the terminal 3 of VR01 to the ground, where TR09 and TR11 are kept removed and VR01 fully turned to the terminal 3 side. Short-circuit the base with emitter.

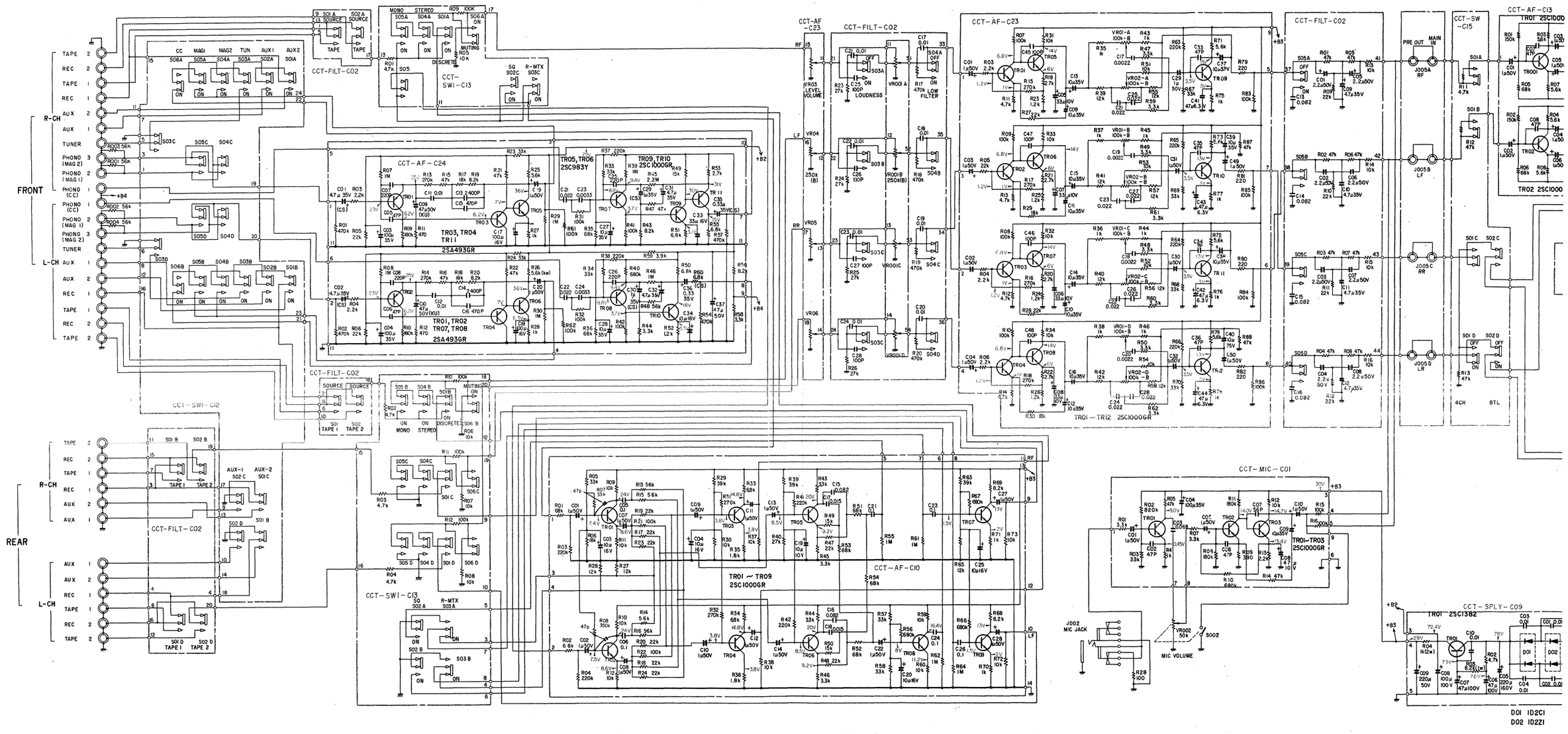
Examine if collector voltage of TR05 (TR06) is adjustable to zero voltage with the power switch on.

If OK ..... Examine if the voltage between collector and emitter of TR13 changes with variation of the semi-fixed VR03 (VR04) when the short-circuit between the base and the emitter of TR13 is released. (Step 1.)

If NOT ..... Check the transistors, TR01, TR03, TR05 and TR06.

10. SCHEMATIC DIAGRAMS

10-1. GENERAL



CCT-SW-C12 (SELECTOR)

S06	PHONO 1 (CC)	[ON]
S05	PHONO 2 (MAG)	
S04	PHONO 3 (MAG)	
S03	TUNER	
S02	AUX-1 (4 CH)	
S01	AUX-2 (4 CH)	

CCT-SW-C14 (SPEAKER)

S01	SPEAKER A	
S02	SPEAKER B	[ON]

CCT-SW-C13 (MODE · MUTING)

S06	MUTING	
S05	MONO	
S04	STEREO	
S03	R-MTX	[ON]
S02	SQ	
S01	DISCRETE	

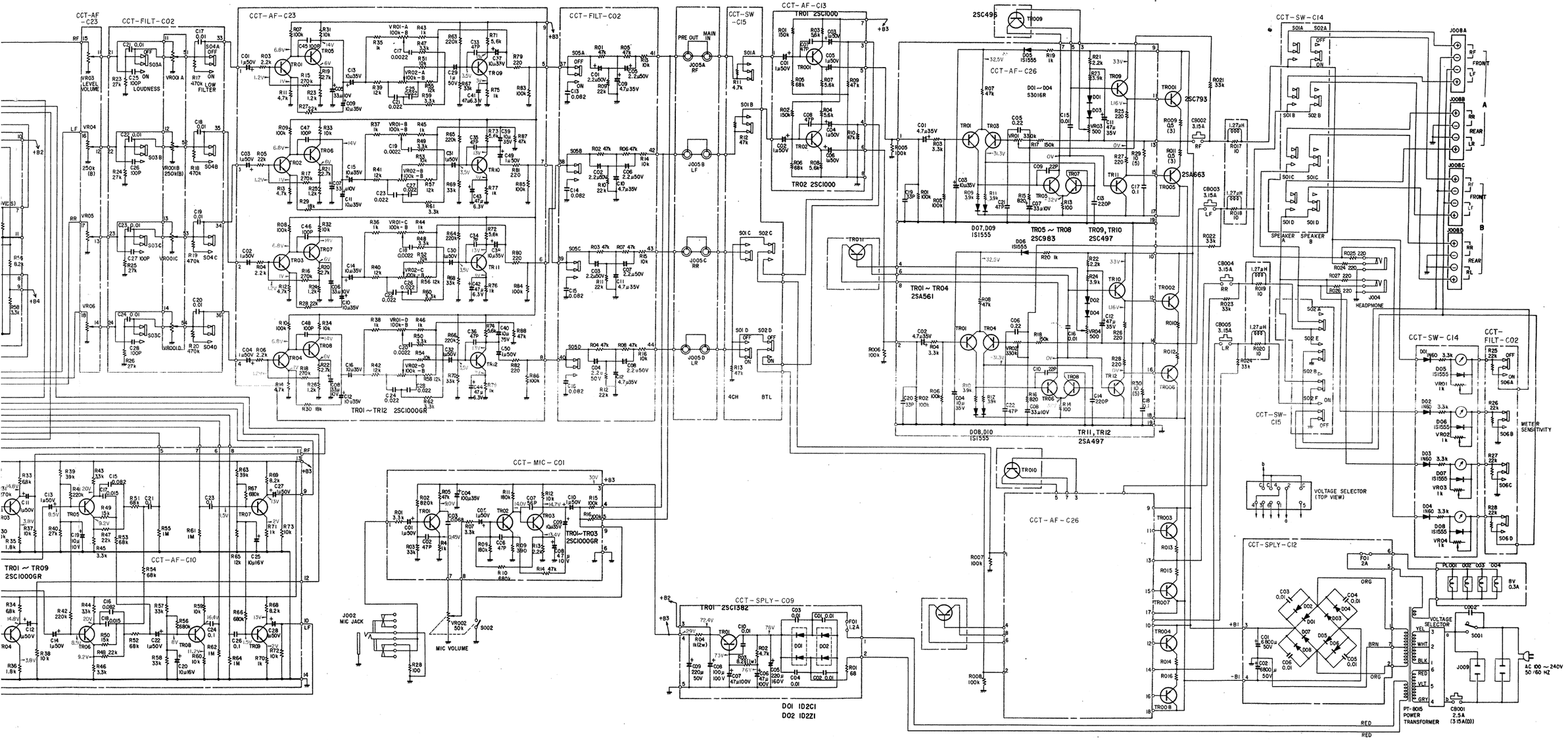
CCT-SW-C15 (BTL · 4 CH)

S02	BTL (2 CH)	
S01	4 CH	[ON]

CCT-FILT-C02 (TAPE · FILTER)

S06	METER SENSITIVITY	
S03	LOUDNESS	
S04	LOW FILTER	
S05	HIGH FILTER	
S01	TAPE 1	[SOURCE]
S02	TAPE 2	[SOURCE]

SB-514



JTING)

[ON]

CCT-SW-C15 (BTL · 4 CH)

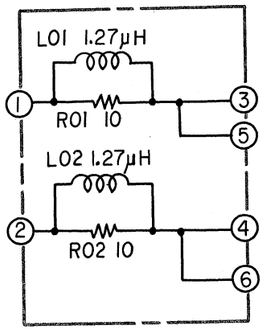
S02	BTL (2 CH)	
S01	4 CH	[ON]

CCT-FILT-C02 (TAPE · FILTER)

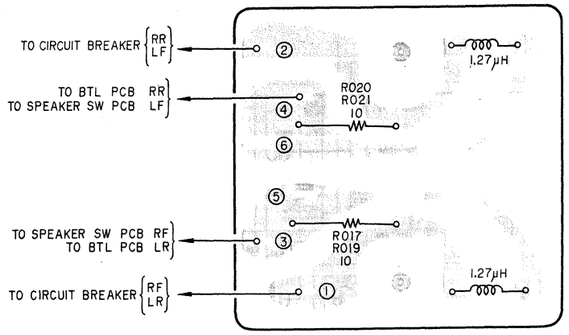
S06	METER SENSITIVITY	
S03	LOUDNESS	
S04	LOW FILTER	
S05	HIGH FILTER	
S01	TAPE 1	[SOURCE]
S02	TAPE 2	[SOURCE]

10-2. COIL CIRCUIT BOARD (CCT-FILT-C03)

SCHEMATIC DIAGRAM

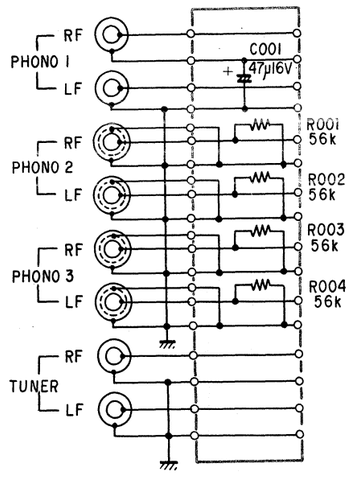


BOTTOM VIEW

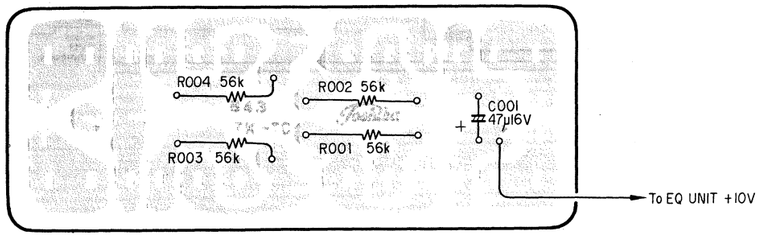


10-3. US SHORT PIN CIRCUIT BOARD (CCT-PIN-C01)

SCHEMATIC DIAGRAM

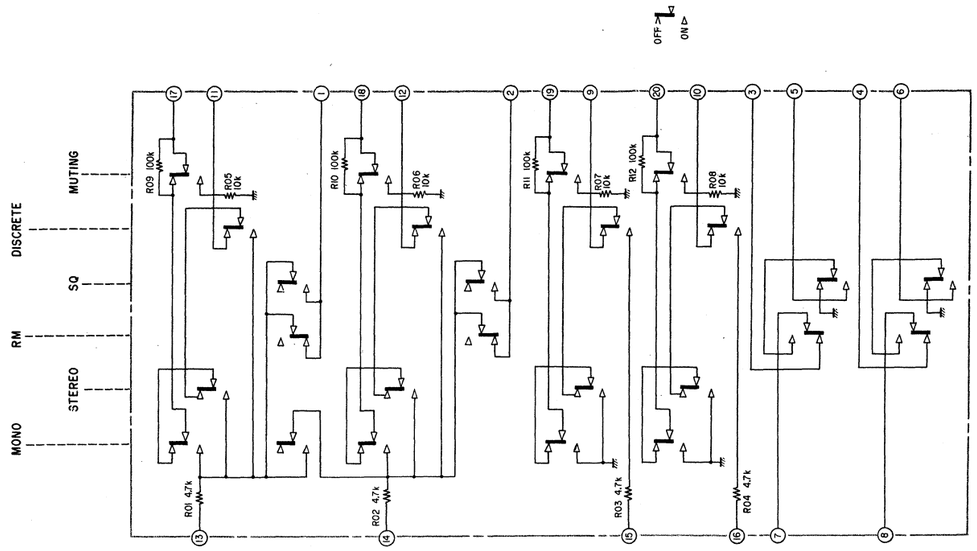


BOTTOM VIEW

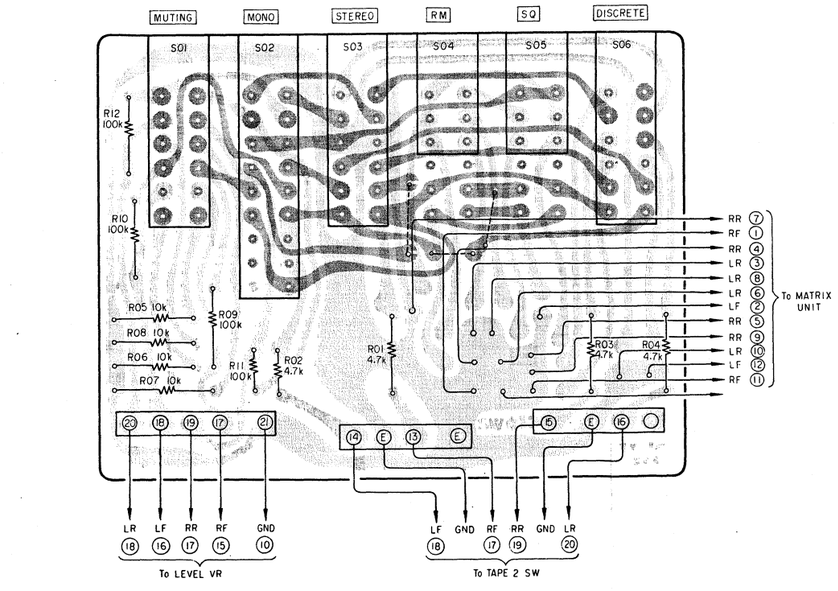


10-4. MODE CIRCUIT BOARD (CCT-SW-C13 and C13A)

SCHEMATIC DIAGRAM

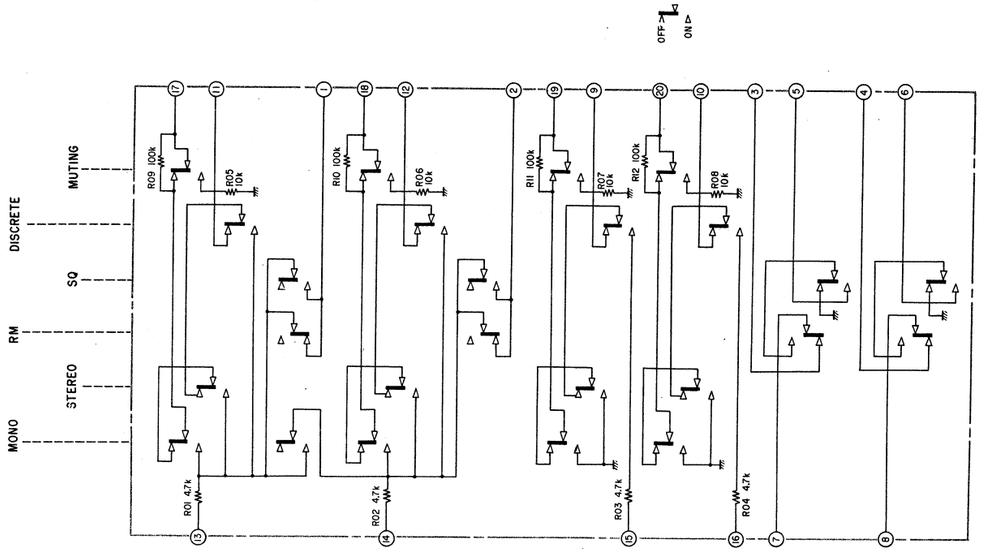


BOTTOM VIEW

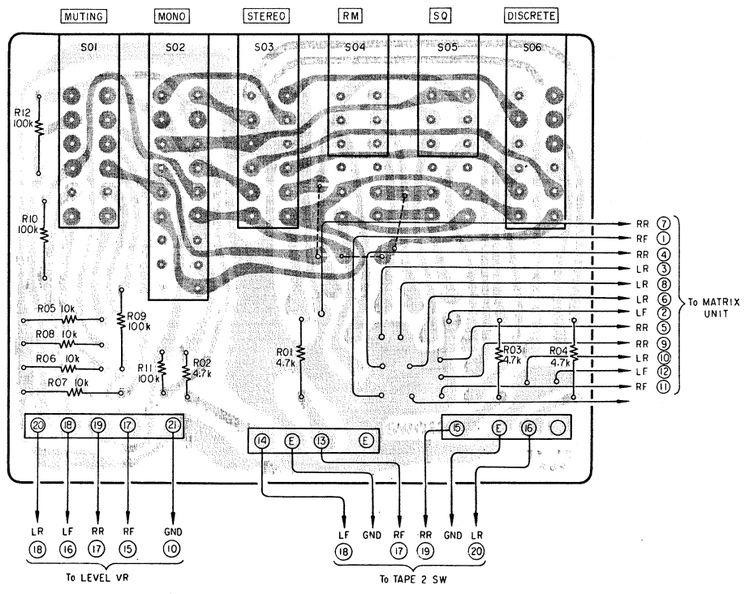


10-4. MODE CIRCUIT BOARD (CCT-SW-C13 and C13A)

SCHEMATIC DIAGRAM

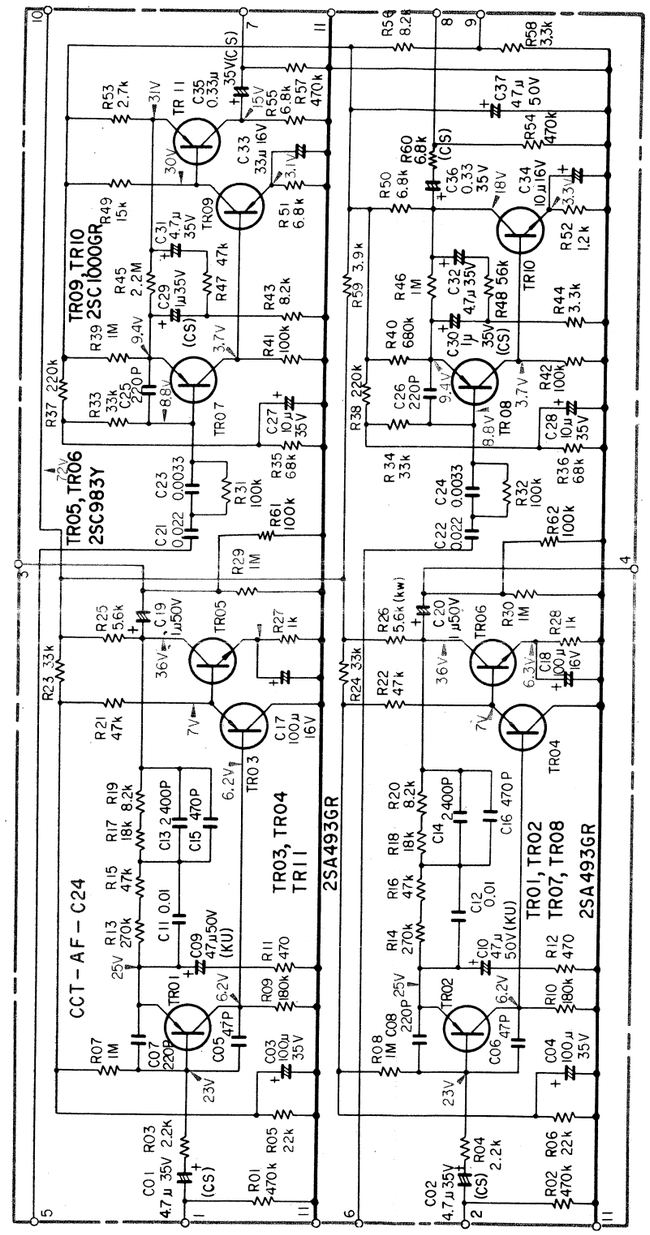


BOTTOM VIEW

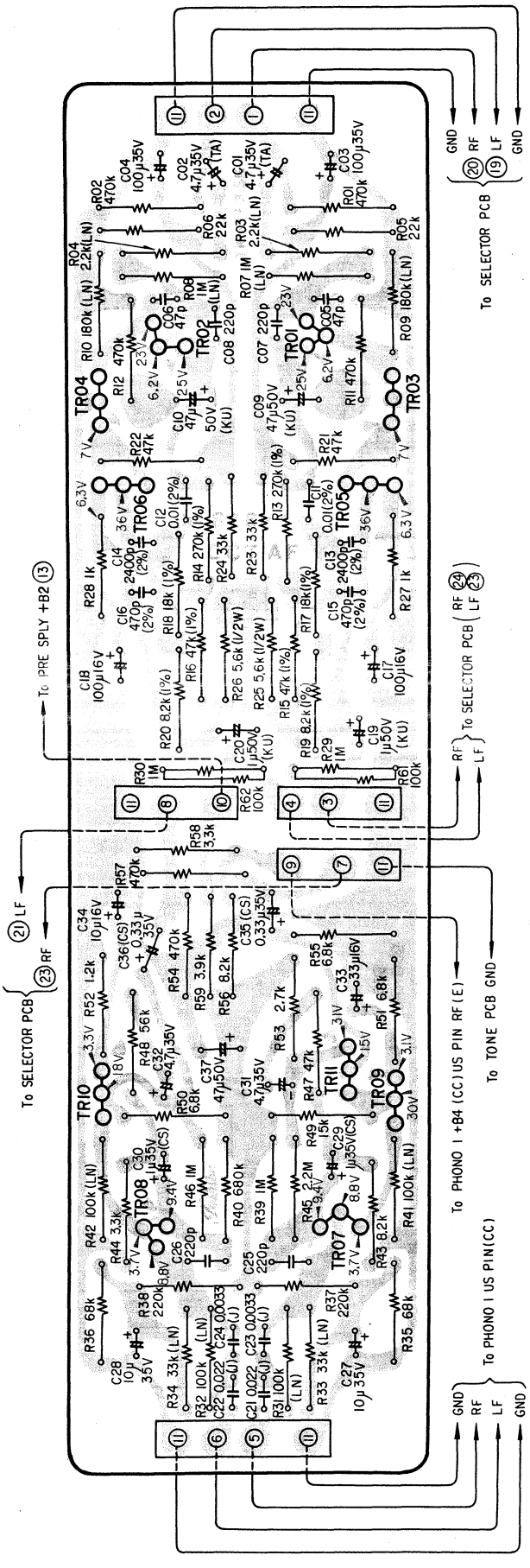


10-5. EQ CIRCUIT BOARD (CCT-AF-C24)

SCHEMATIC DIAGRAM

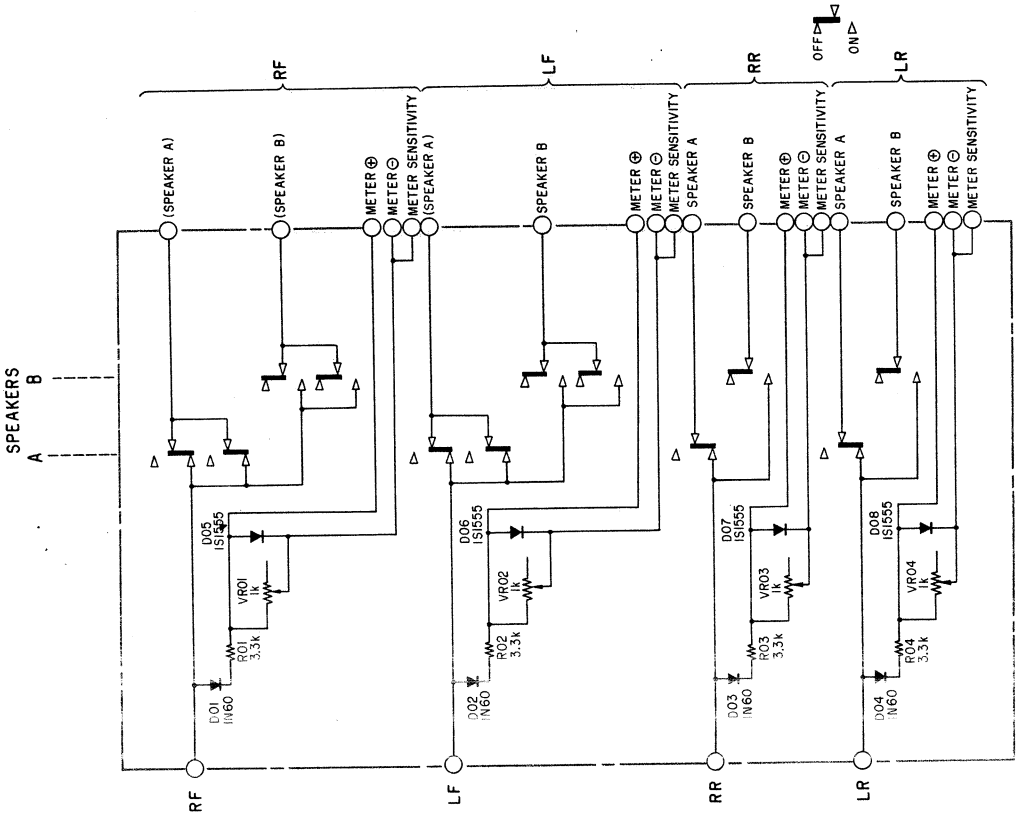


BOTTOM VIEW

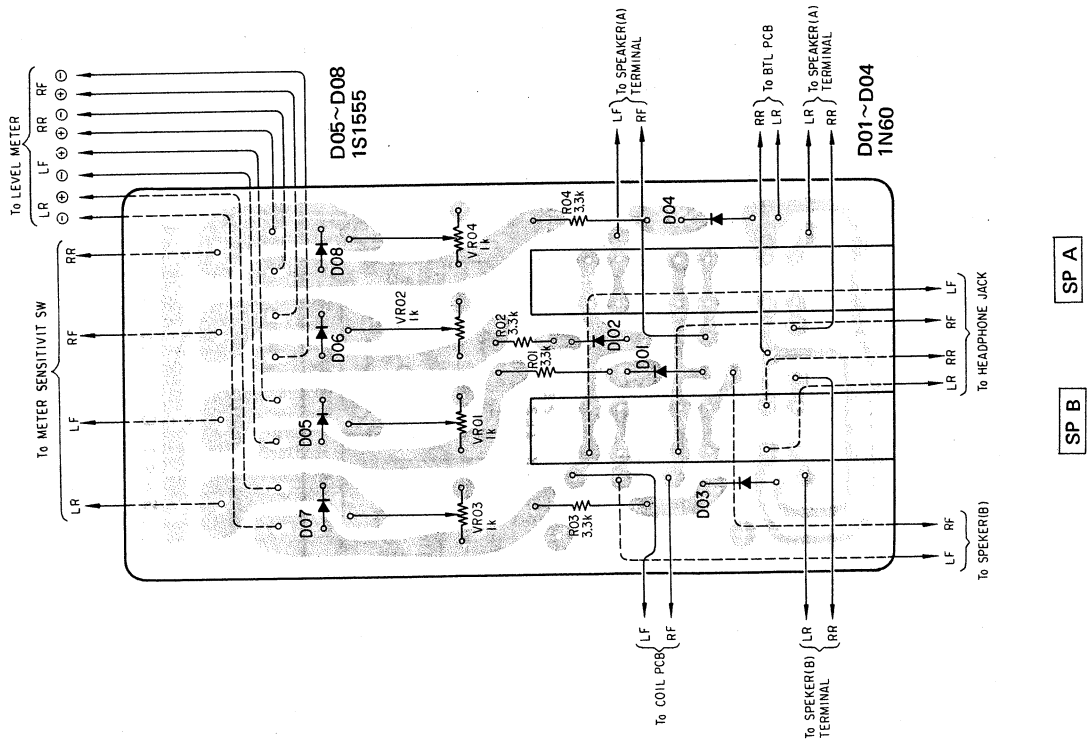

To PRE SPLY +B2 (13)
To SELECTOR PCB (21) LF (23) RF
To SELECTOR PCB RF (24) LF (23)
To SELECTOR PCB GND (20) RF (19) LF GND
To PHONO I +B4 (CC) US PIN RF(E)
To TONE PCB GND
To PHONO I US PIN(CC) GND RF LF GND
TR01
TR02
TR03
TR04
TR05
TR06
TR07
TR08
TR09
TR10
TR11

10-6. SPEAKER SWITCH CIRCUIT BOARD (CCT-SW-C14)

SCHEMATIC DIAGRAM

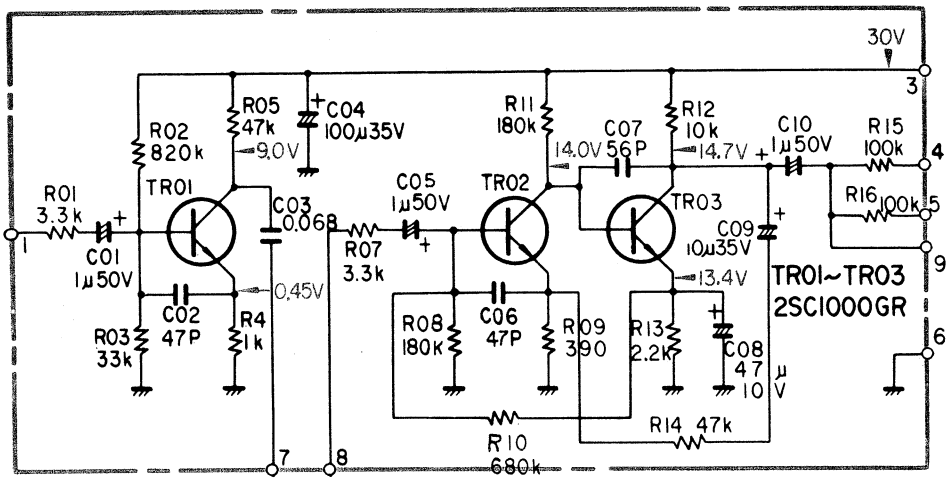


BOTTOM VIEW

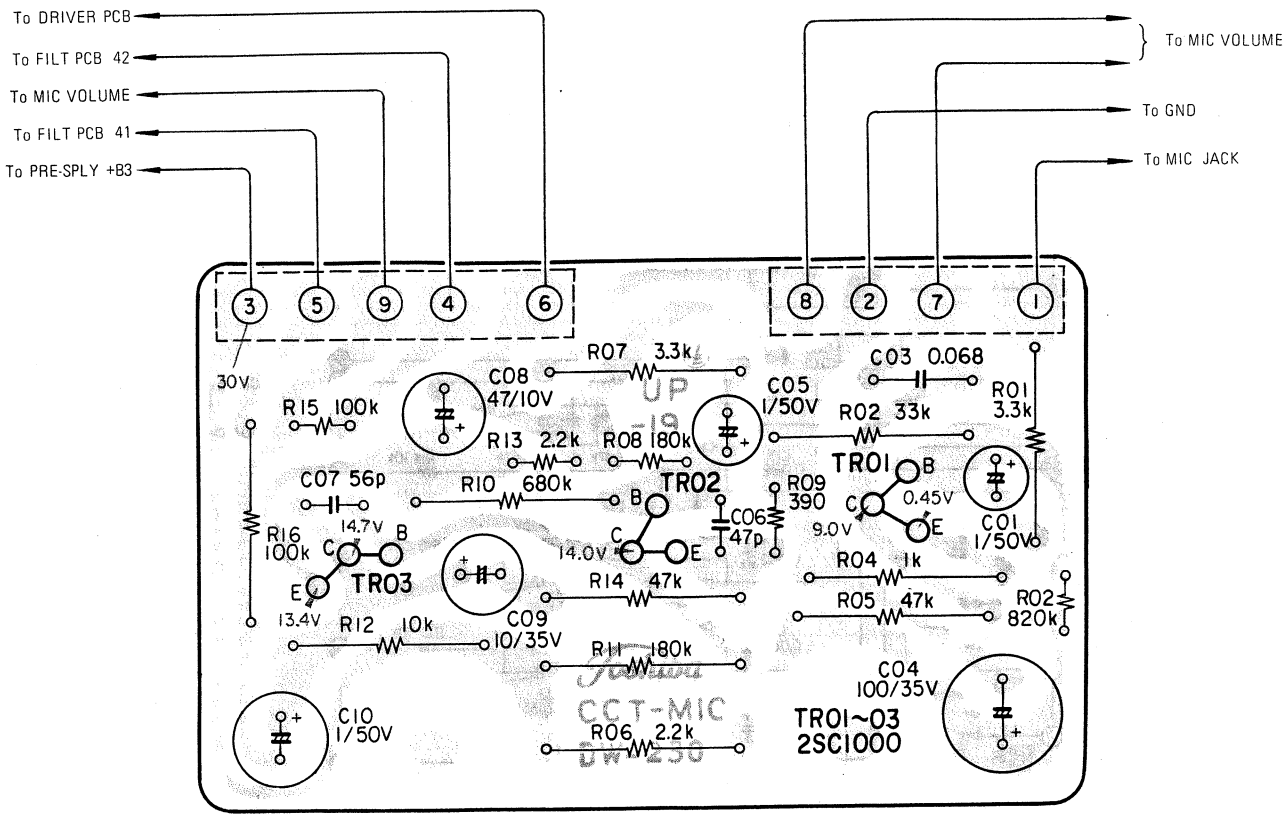


10-7. MIC CIRCUIT BOARD (CCT-MIC-C01)

SCHEMATIC DIAGRAM

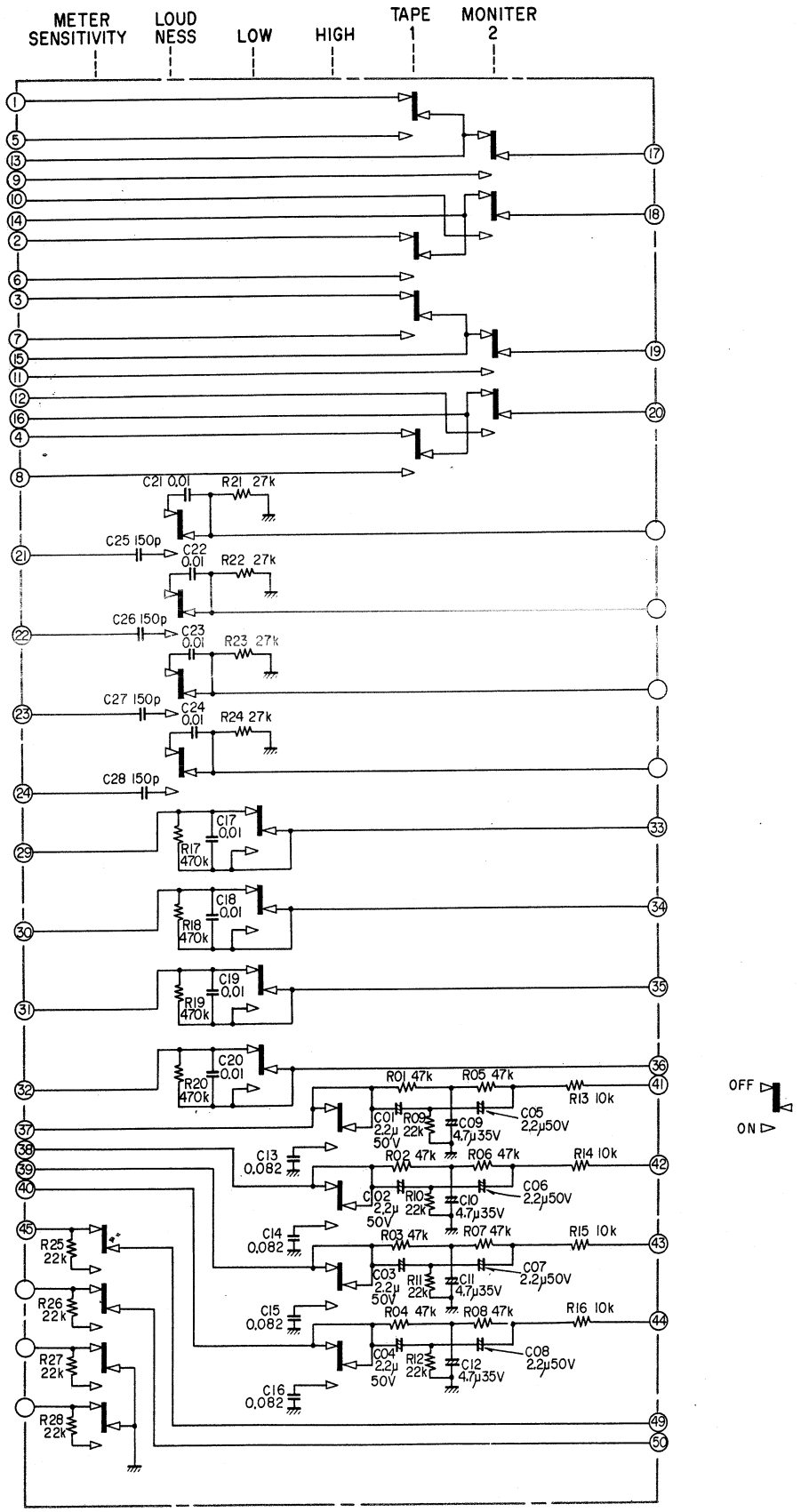


BOTTOM VIEW

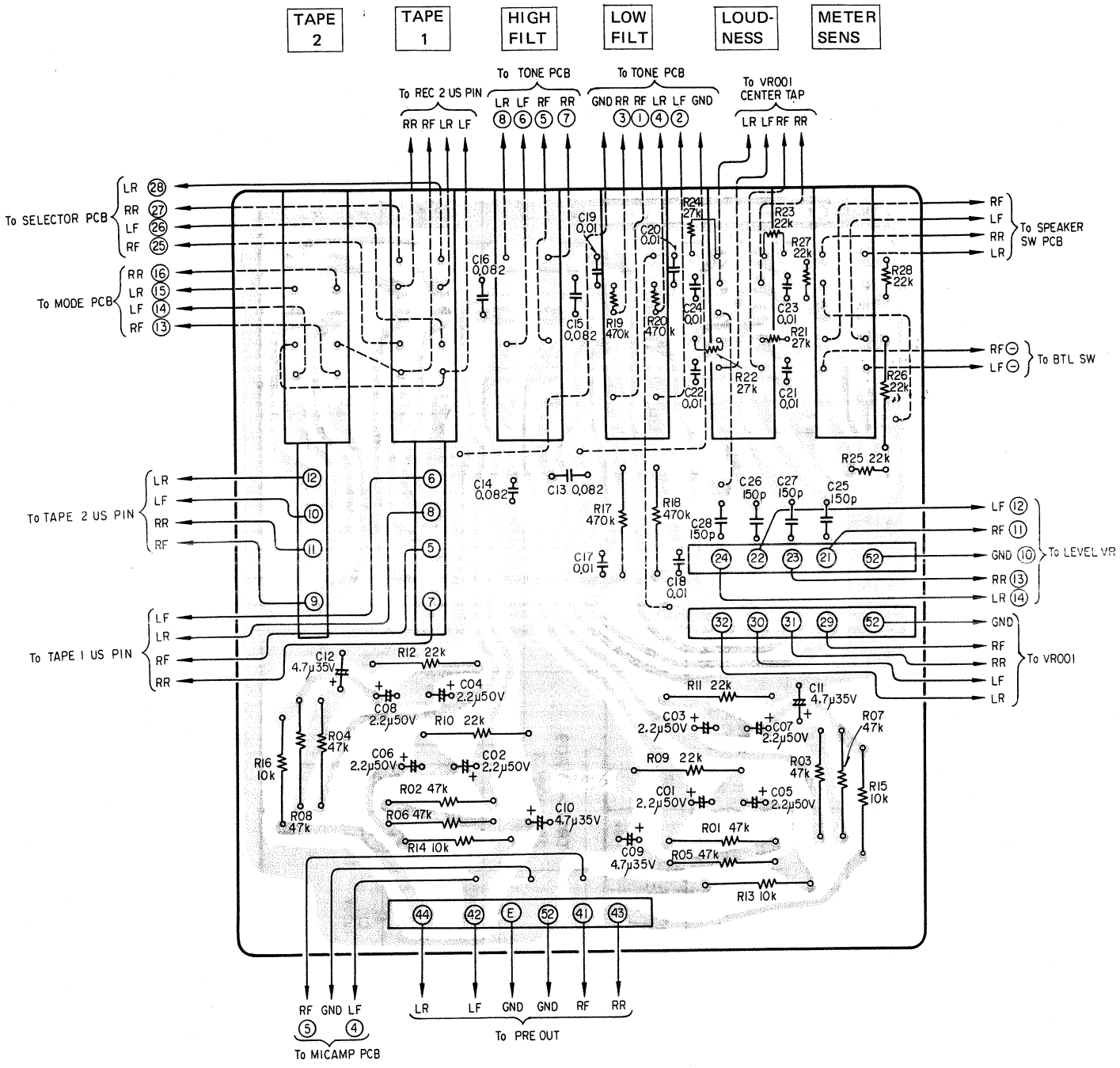


10-8. ACCESSORY CIRCUIT BOARD (CCT-FILT-C02)

SCHEMATIC DIAGRAM

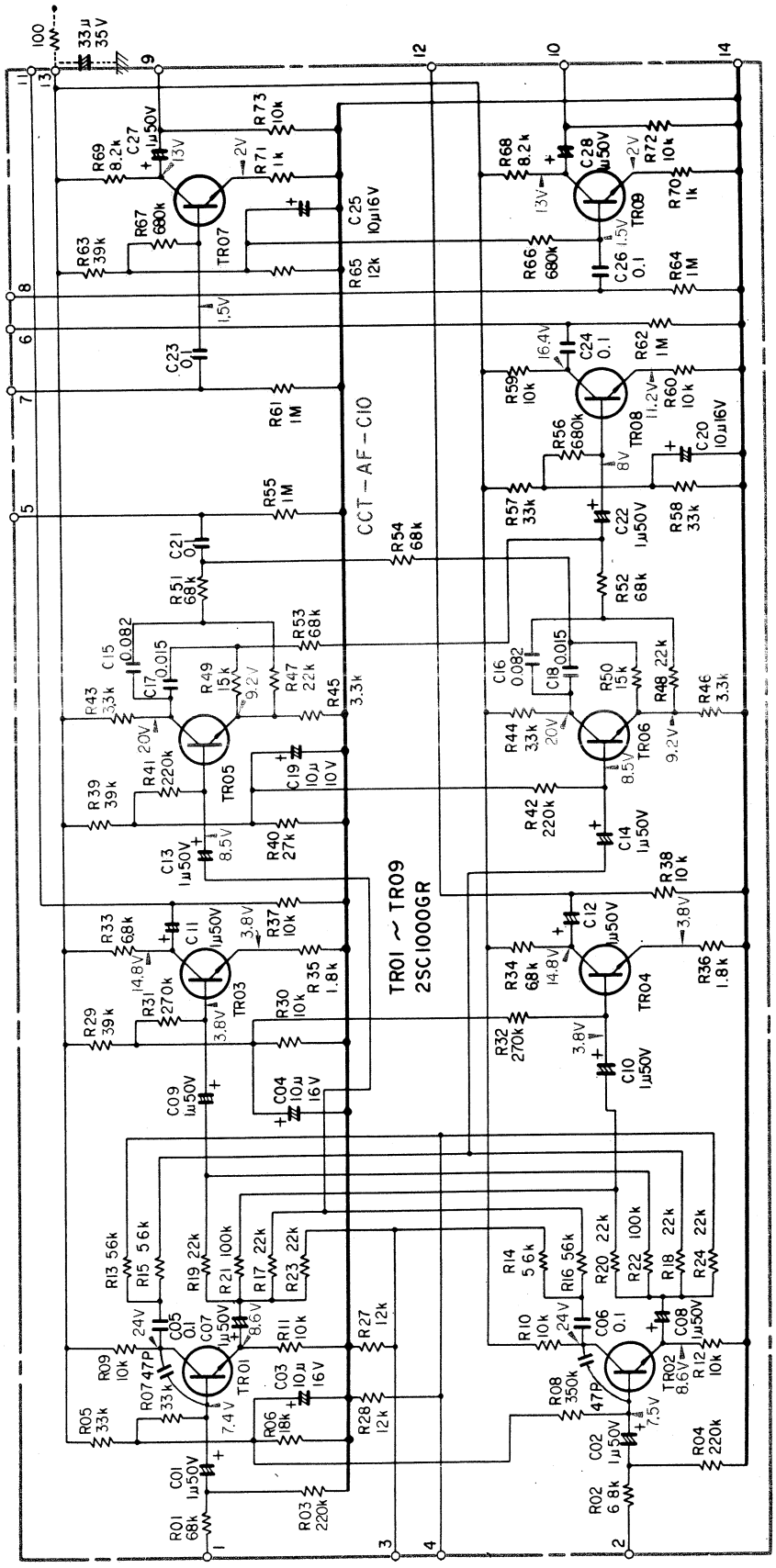


BOTTOM VIEW

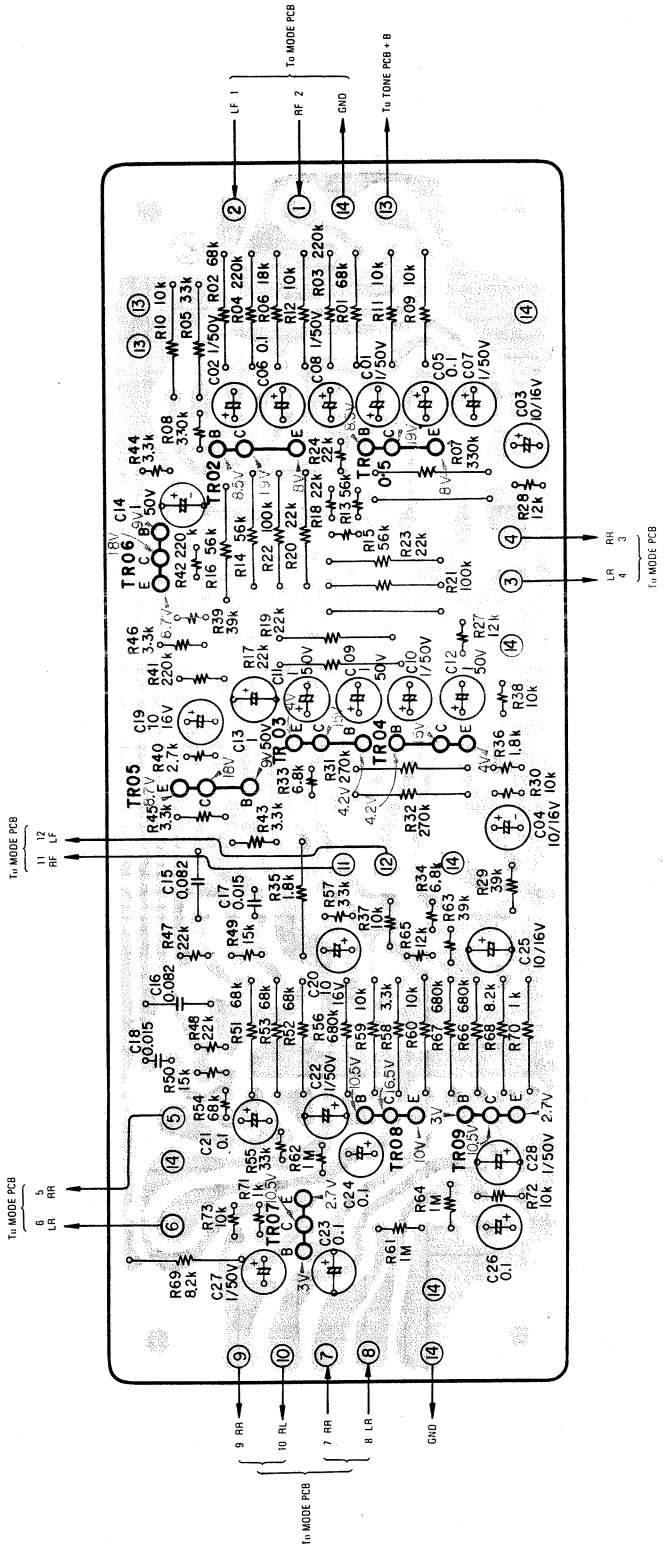

TAPE 2
TAPE 1
HIGH FILT
LOW FILT
LOUD-NESS
METER SENS
To REC 2 US PIN
RR RF LR LF
To TONE PCB
LR LF RF RR
8 6 5 7
To TONE PCB
GND RR RF LR LF GND
3 1 4 2
To VR001 CENTER TAP
LR LF RF RR
To SELECTOR PCB
LR 28
RR 27
LF 26
RF 25
To MODE PCB
RR 16
LR 15
LF 14
RF 13
To TAPE 2 US PIN
LR
LF
RR
RF
To TAPE 1 US PIN
LF
LR
RF
RR
To SPEAKER SW PCB
RF
LF
RR
LR
To BTL SW
RF⊖
LF⊖
To LEVEL VR
LF 12
RF 11
GND 10
RR 13
LR 14
To VR001
GND
RF
RR
LF
LR
RF GND LF
5 4
To MICAMP PCB
LR LF GND GND RF RR
To PRE OUT
C12 4.7µ35V
R12 22k
C08 2.2µ50V
C04 2.2µ50V
R10 22k
C06 2.2µ50V
C02 2.2µ50V
R02 47k
R06 47k
R14 10k
C10 4.7µ35V
R16 10k
R04 47k
R08 47k
C16 0.082
C15 0.082
C19 0.01
R19 470k
C20 0.01
R20 470k
R24 27k
C24 0.01
C22 0.01
R22 27k
R23 22k
C23 0.01
R27 22k
R21 27k
C21 0.01
R28 22k
R26 22k
R25 22k
C14 0.082
C13 0.082
R17 470k
C17 0.01
R18 470k
C18 0.01
C26 150p
C27 150p
C25 150p
C28 150p
R11 22k
C11 4.7µ35V
C03 2.2µ50V
C07 2.2µ50V
R09 22k
C01 2.2µ50V
C05 2.2µ50V
R01 47k
R05 47k
C09 4.7µ35V
R13 10k
R07 47k
R03 47k
R15 10k

10-9. MATRIX CIRCUIT BOARD (CCT-AF-C10)

SCHEMATIC DIAGRAM

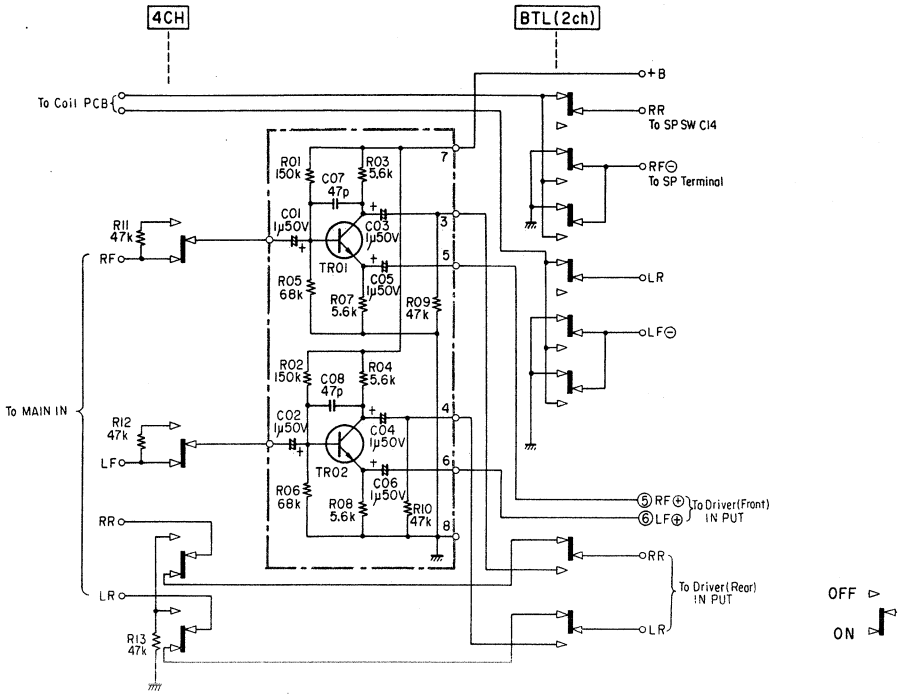


BOTTOM VIEW

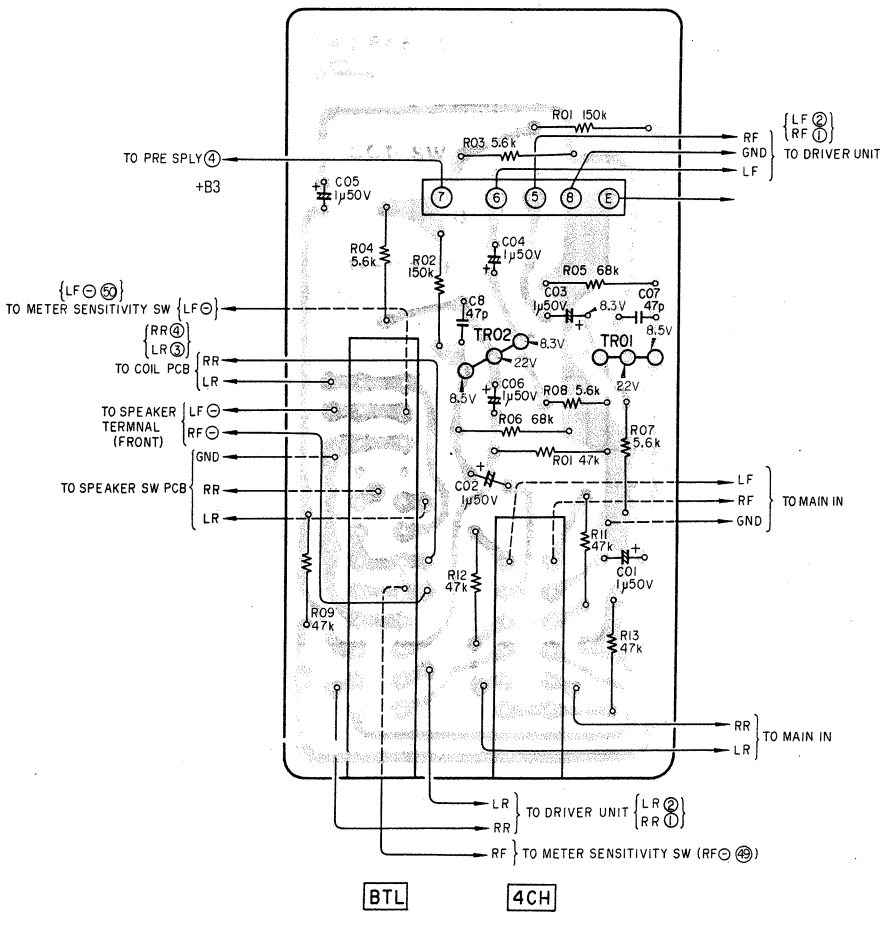

LF 1
RF 2
GND
To MODE PCB
To TONE PCB + B
TR01
TR02
TR03
TR04
TR05
TR06
TR07
TR08
TR09
9 RR
10 RL
7 RR
8 LR
GND
To MODE PCB

10-10. BTL CIRCUIT BOARD (CCT-AF-C13)

SCHEMATIC DIAGRAM

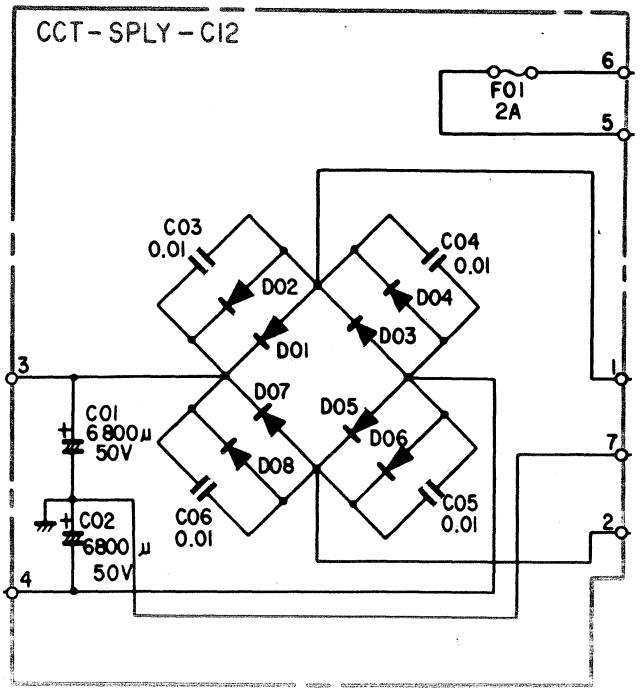


BOTTOM VIEW

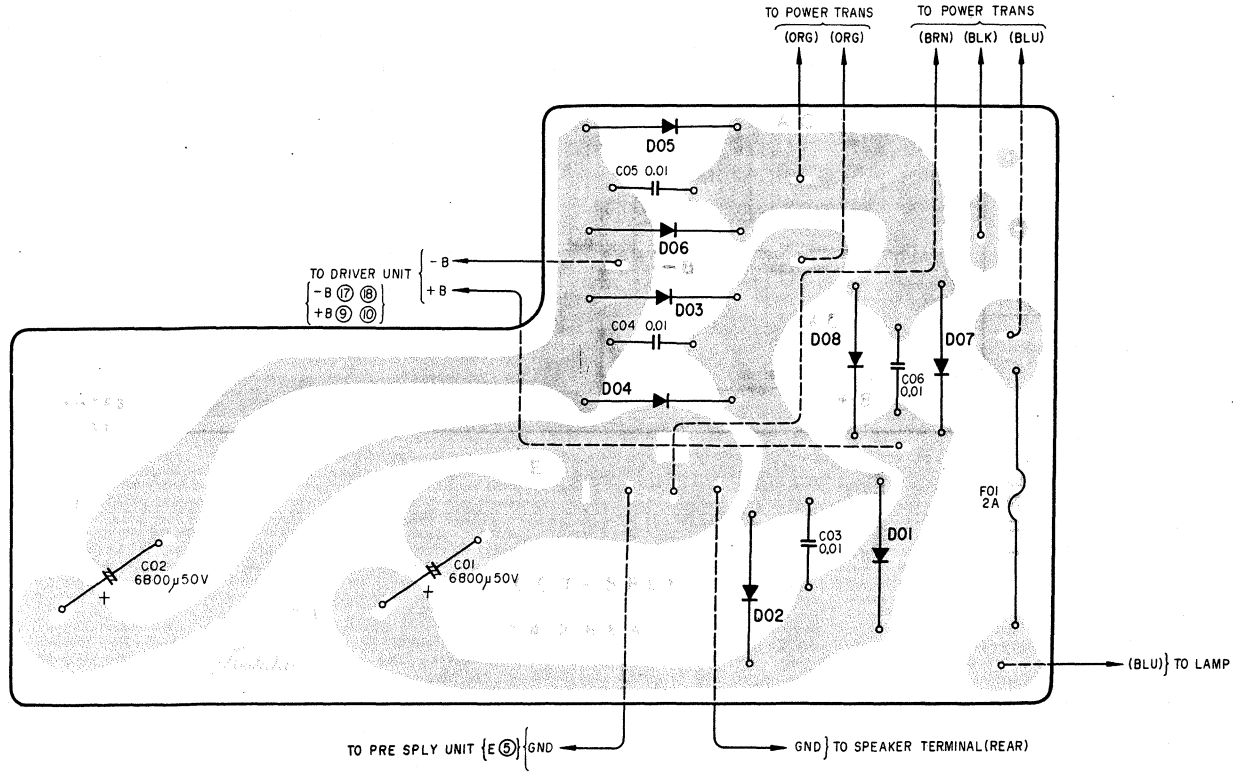


10-11. MAIN SUPPLY CIRCUIT BOARD (CCT-SPLY-C12)

SCHEMATIC DIAGRAM

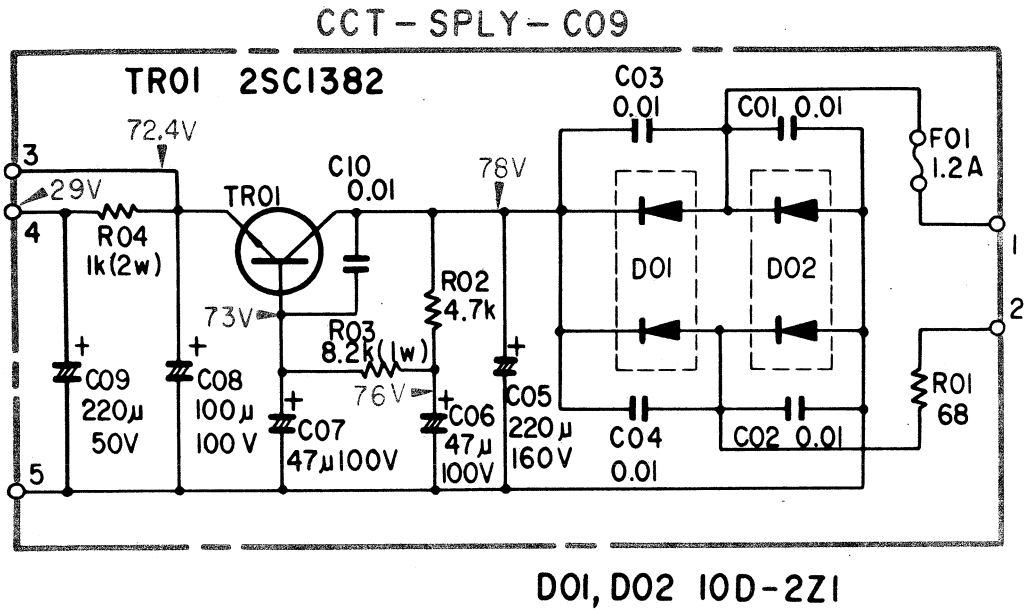


BOTTOM VIEW



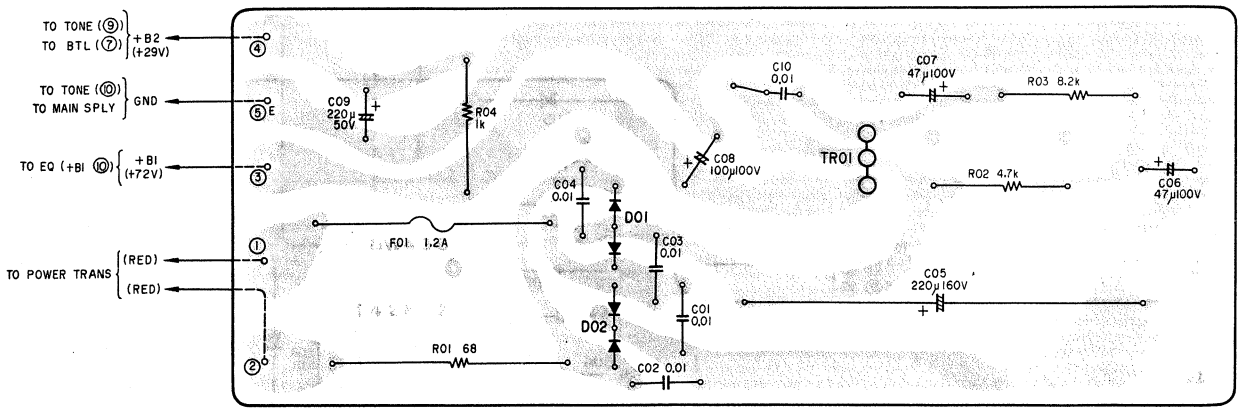
10-12. PRE SUPPLY CIRCUIT BOARD (CCT-SPLY-C14)

SCHEMATIC DIAGRAM



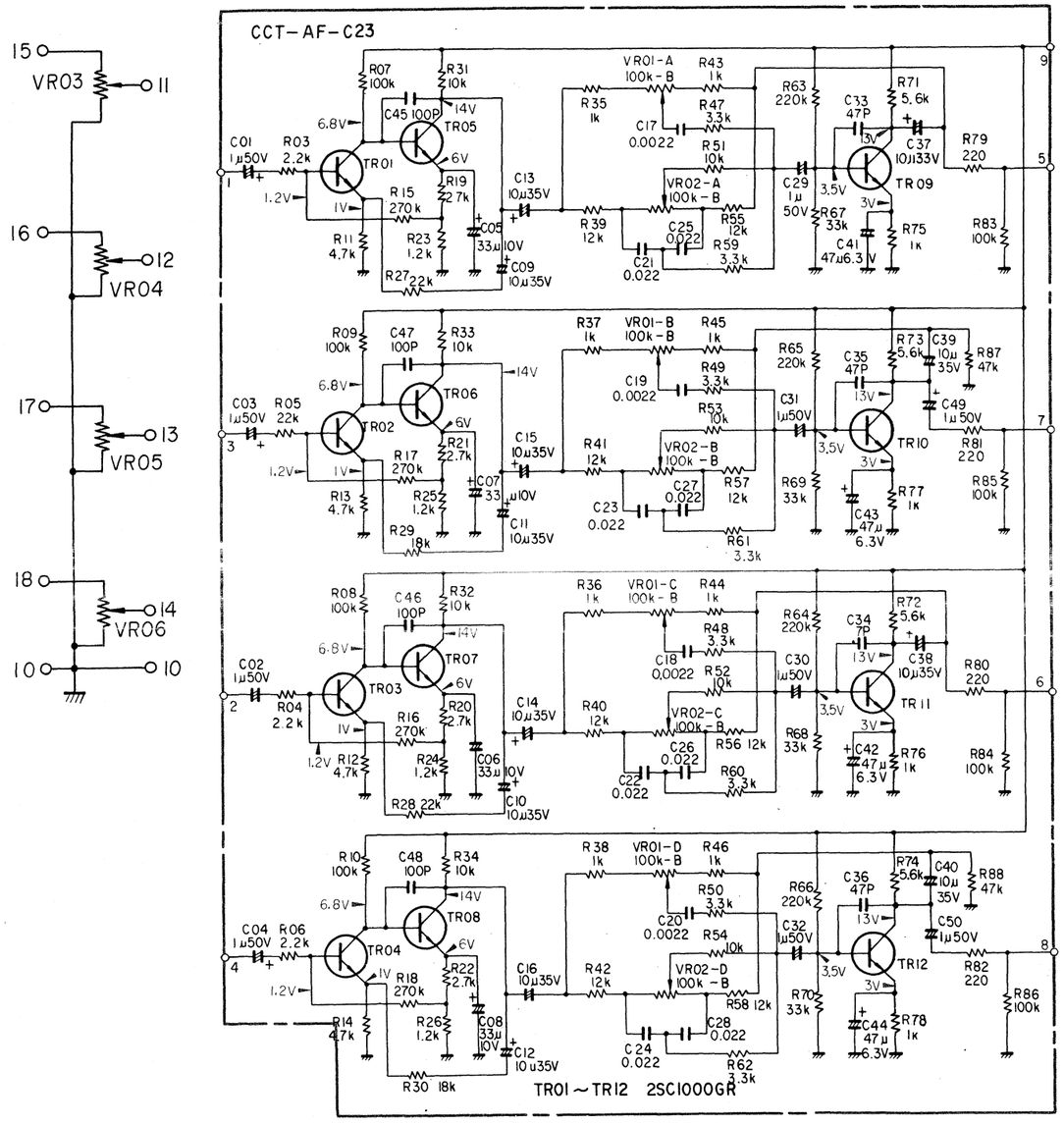
D01, D02 10D-2Z1

BOTTOM VIEW

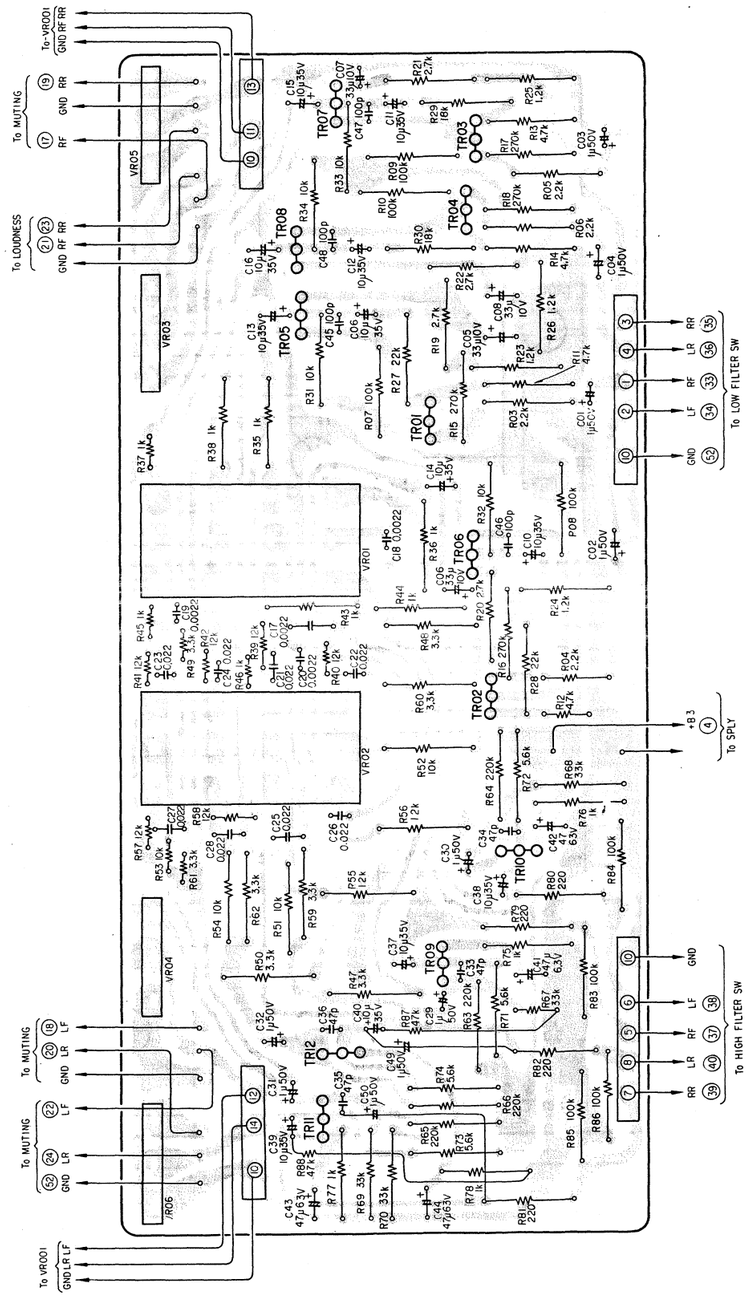


10-13. TONE CIRCUIT BOARD (CCT-AF-C23)

SCHEMATIC DIAGRAM

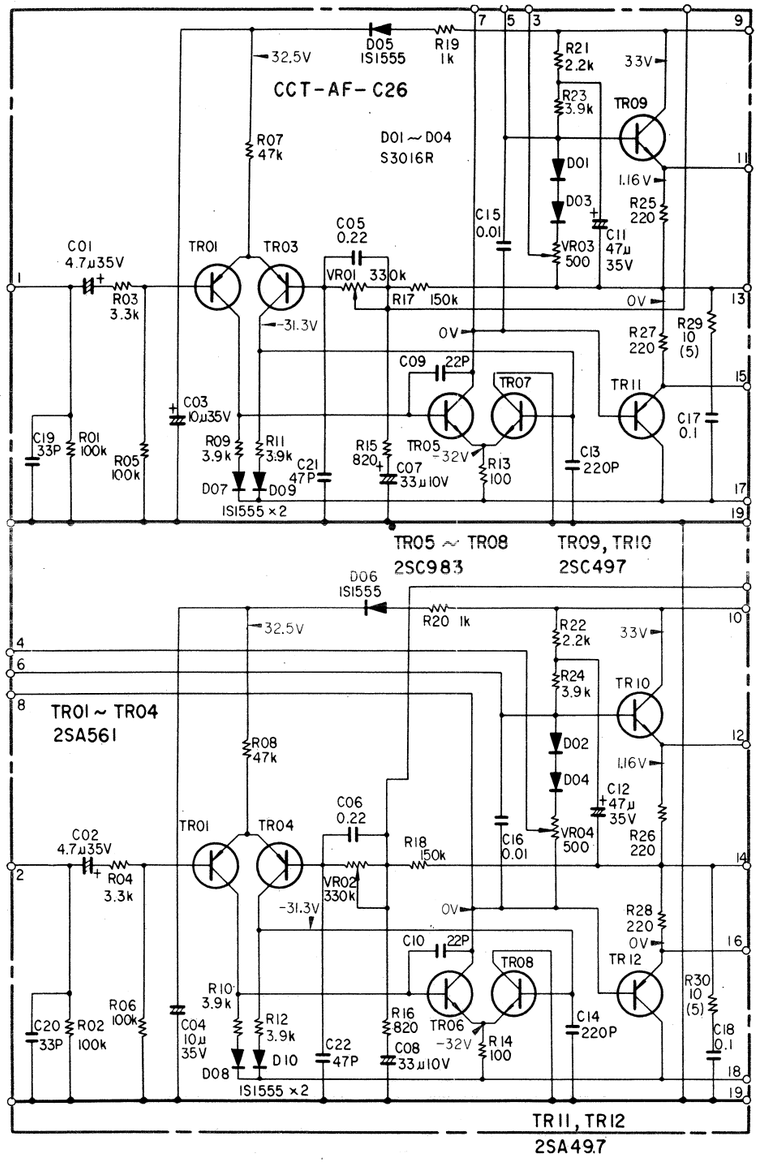


BOTTOM VIEW

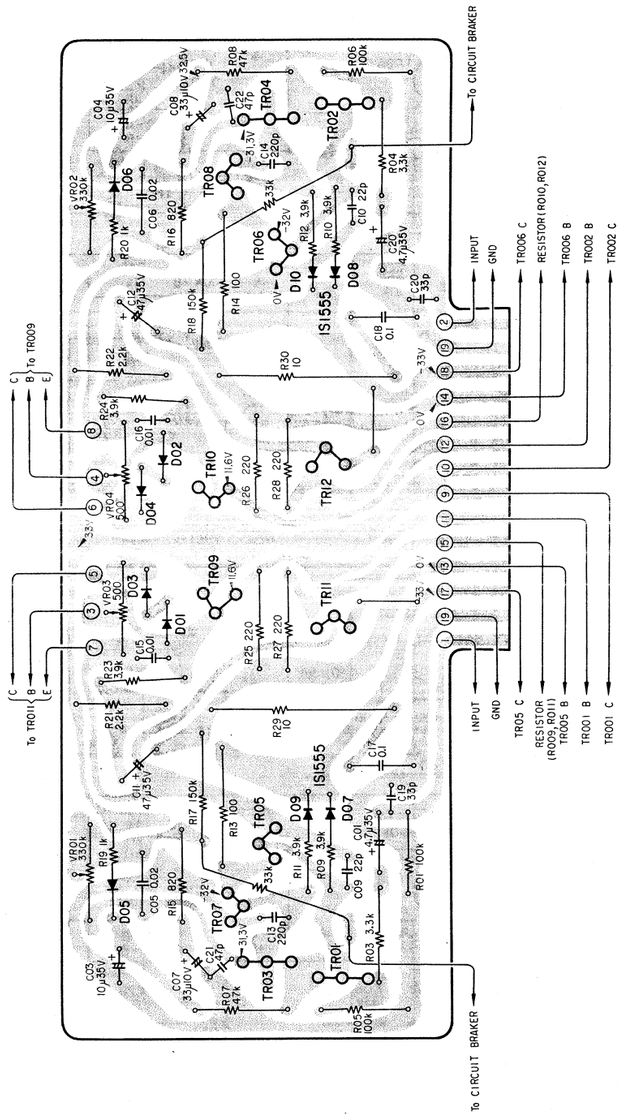


10-14. DRIVER CIRCUIT BOARD (CCT-AF-C26)

SCHEMATIC DIAGRAM

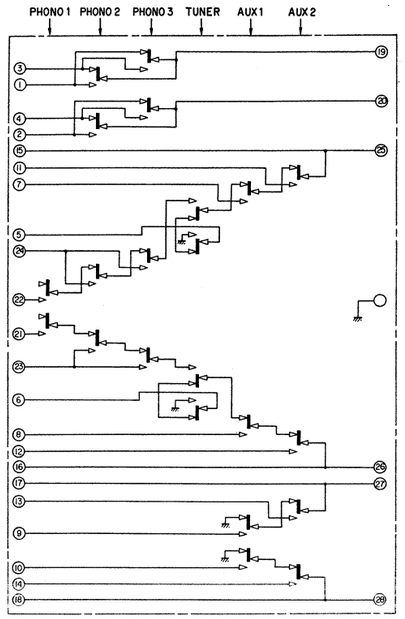


BOTTOM VIEW

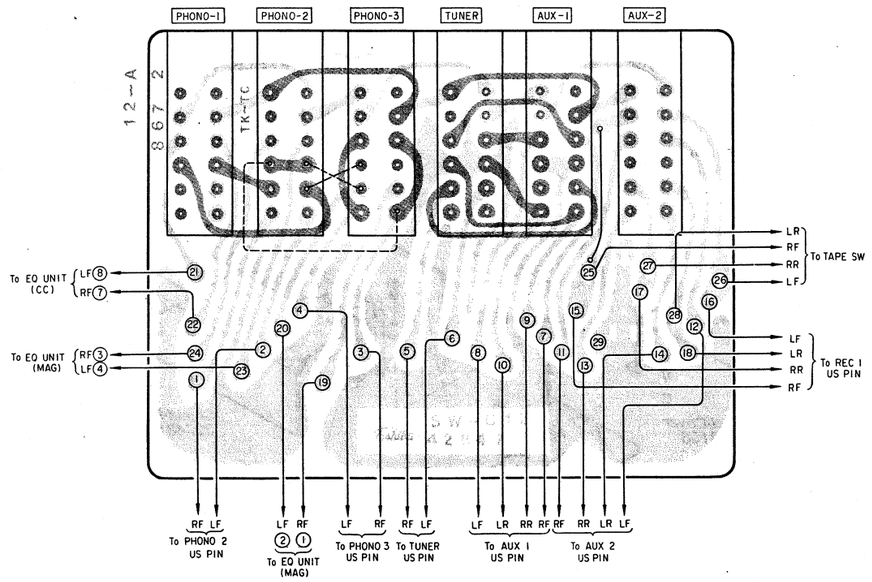


10-15. SELECTOR CIRCUIT BOARD (CCT-SW1-C12 & C12A)

SCHEMATIC DIAGRAM

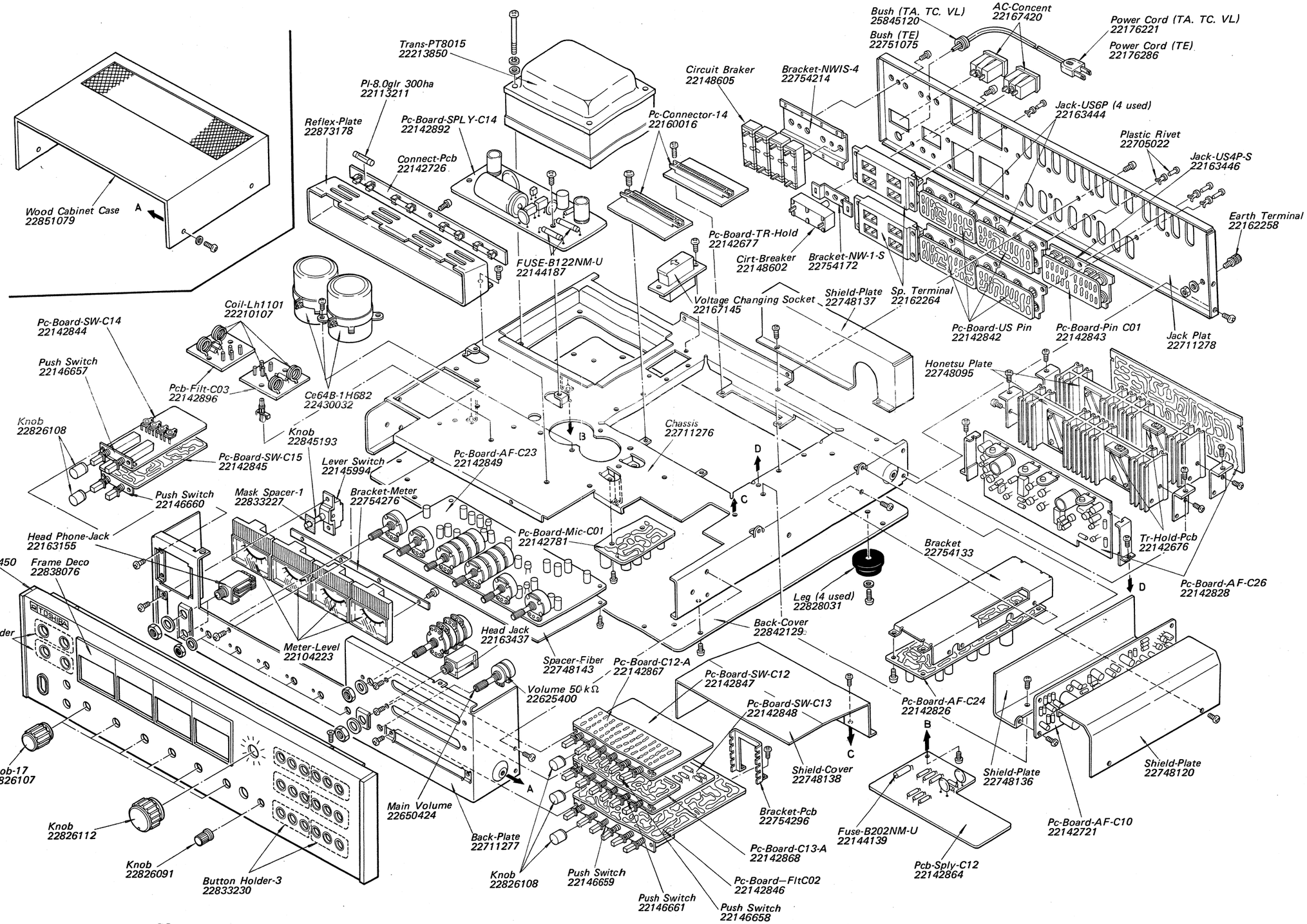


BOTTOM VIEW



MEMO

11. EXPLODED VIEW



12. PARTS LIST

SYMBOL NO.	PABT NO.	DESCRIPTION
Pre SUPPLY UNIT ASSEMBLY (CCT-SPLY-C14)		
RESISTORS		
R01	22570011	68 ohm ±10% 1W RD
R02	22570057	4.7k ohm ±10% 2W RD
R03	22570066	8.2k ohm ±10% 2W RD
R04	22570024	1k ohm ±10% 2W RD
CAPACITORS		
C01,02,03,04	22340030	0.01μF 500V
C05	22450016	220μF 160WV
C06,07	22440036	47μF 100WV
C08	22440101	100μF 100WV
C09	22448221	220μF 50WV
SEMICONDUCTORS		
D01	37682020	1D-2C1
D02	37682060	1D-2Z1
TR01	31231382	2SC1382-O
F01	22144187	FUSE 1.2A
MAIN SUPPLY UNIT ASSEMBLY (CCT-SPLY-C12)		
CAPACITORS		
C01,02,03,04	22340030	0.01μF 500V
SEMICONDUCTORS		
D01,02,03,04 05,06,07,08		1S2583
F01	22144139	FUSE 2A
MIC UNIT ASSEMBLY (CCT-MIC-C01)		
RESISTORS		
R01	22544332	3.3k ohm ±10% 1/8W RD
R02	22554824	820k ohm ±10% 1/8W Single Ended
R03	22544333	33k ohm ±10% 1/8W RD
R04	22544102	1k ohm ±10% 1/8W RD
R05	22544473	47k ohm ±10% 1/8W RD
R06	22544222	2.2k ohm ±10% 1/8W RD
R07	22544332	3.3k ohm ±10% 1/8W RD
R08	22554184	180k ohm ±10% 1/8W Single Ended
R09	22554391	390k ohm ±10% 1/8W Single Ended
R10	22544684	680k ohm ±10% 1/8W RD
R11	22544184	180k ohm ±10% 1/8W RD
R12	22544103	10k ohm ±10% 1/8W RD
R13	22554222	2.2k ohm ±10% 1/8% Single Ended
R14	22544473	47k ohm ±10% 1/8W RD
R15	22554104	100k ohm ±10% 1/8W Single Ended
R16	22544104	100k ohm ±10% 1/8W RD

SYMBOL NO.	PART NO.	DESCRIPTION
CAPACITORS		
C01	22448109	1μF 50WV CF
C02	22362470	47 pF ±10% 50V CC (SL)
C03	22373683	0.068μF ±20% 50V Mylar
C04	22447101	100μF 35WV CE
C05	22448109	1μF 50WV CE
C06	22362470	47 pF ±10% 50V CC (SL)
C07	22362560	56 pF ±10% 50V CC (SL)
C08	22447470	47μF 35WV CE
C09	22447100	10μF 35WV CE
C10	22448109	1μF 50WV CE
SEMICONDUCTORS		
TR01,02,03	31231000	2SC 1000-GR
TONE UNIT ASSEMBLY (CCF-AF-C23)		
RESISTORS		
R03,04,05,06	22543222	2.2k ohm ±5% 1/8W RD
R07,08,09,10, R83,84,85,86	22543104	100k ohm ±5% 1/8W RD
R11,12,13,14	22543472	4.7k ohm ±5% 1/8W RD
R15,16,17,18	22543274	270k ohm ±5% 1/8W RD
R19,20,21,22	22543272	2.7k ohm ±5% 1/8W RD
R23,24,25,26	22543122	1.2k ohm ±5% 1/8W RD
R27,28	22543223	22k ohm ±5% 1/8W RD
R29,30	22543183	18k ohm ±5% 1/8W RD
R31,32,33,34 51,52,53,54	22543103	10k ohm ±5% 1/8W RD
R35,36,38,43, 44,75,76,77,78	22543102	1k ohm ±5% 1/8W RD
R37,45,46	22553102	1k ohm ±5% 1/8W Single Ended
R39,40,41,42 57,58	22553123	12k ohm ±5% 1/8W Single Ended
R47,48,50,59 60,62	22543332	3.3k ohm ±5% 1/8W RD
R49,61	22553332	3.3k ohm ±5% 1/8W Single Ended
R55,56	22543123	12k ohm ±5% 1/8W RD
R63,64,65,66	22543224	220k ohm ±5% 1/8W RD
R67	22553333	33k ohm ±5% 1/8W Single Ended
R68,69,70	22543333	33k ohm ±5% 1/8W RD
R71,72,73,74	22543562	5.6k ohm ±5% 1/8W RD
R79,80,81,82	22543221	220k ohm ±5% 1/8W RD
R87,88	22543473	47k ohm ±5% 1/8W RD
VR01,02	22650425	100k ohm Bx4 Tone
VR03,04,05,06	22640402	250k ohm B Volume
CAPACITORS		
C01,02,03,04 29,30,31,32, 49,50	22448109	1μ 50V CE
C05,06,07,08	22443330	33μ ±20% 10V CE
C09,10,11,12, 13,14,15,16, 37,38,39,40	22447100	10μ 35V CE

SYMBOL NO.	PART NO.	DESCRIPTION
C17,18,19,20	22373222	0.0022μF ±20% 50V Mylar
C21,22,23,24	22373223	0.022μF ±20% 50V Mylar
25,26,27,28		
C33,34,35,36	22362470	47p ±10% 50V (SL)
C41,42,43,44	22442470	47μF ±10% 6.3V
C45,46,47,48	22362101	100p ±10% 50V (SL)
SEMICONDUCTORS		
TR01,02,03,04 05,06,07,08, 09,10,11,12	31231000	2SC-1000 GR
MATRIX UNIT ASSEMBLY (CCT-AF-C10) **RESISTORS**		
R01,02,51,52, 53	22544683	68k ohm ±10% 1/8W RD
R03,04	22544224	220k ohm ±10% 1/8W RD
R05,58	22544333	33k ohm ±10% 1/8W RD
R06	22544183	18k ohm ±10% 1/8W RD
R07	22544334	330k ohm ±10% 1/8W RD
R08	22554334	330k ohm ±10% 1/8W Single Ended
R09,10,11,12, 59,60	22544103	10k ohm ±10% 1/8W RD
R13,15	22554563	56k ohm ±10% 1/8W Single Ended
R14,16	22544563	56k ohm ±10% 1/8W RD
R17,19,20,23	22544223	22k ohm ±10% 1/8W RD
R18,24,47,48	22554223	22k ohm ±10% 1/8W Single Ended
R21,22	22544104	100k ohm ±10% 1/8W RD
R27,28	22554123	12k ohm ±10% 1/8W Single Ended
R29,39,63	22554393	39k ohm ±10% 1/8W Single Ended
R30,37,38,72, 73	22554103	10k ohm ±10% 1/8W Single Ended
R31,32	22544274	270k ohm ±10% 1/8W RD
R33,34	22554682	6.8k ohm ±10% 1/8W Single Ended
R35	22544182	1.8k ohm ±10% 1/8W RD
R36	22554182	1.8k ohm ±10% 1/8W Single Ended
R40	22554273	27k ohm ±10% 1/8W Single Ended
R41,42	22554224	220k ohm ±10% 1/8W Single Ended
R43,44,45,46	22554332	3.3k ohm ±10% 1/8W Single Ended
R49,50	22554153	15k ohm ±10% 1/8W Single Ended
R54	22554683	68k ohm ±10% 1/8W Single Ended
R55,61,62,64	22554105	1M ohm ±10% 1/8W Single Ended
R56,66,67	22544684	680k ohm ±10% 1/8W RD
R57	22554333	33k ohm ±10% 1/8W Single Ended
R65	22554123	12k ohm ±10% 1/8W Single Ended
R68,69	22544822	8.2k ohm ±10% 1/8W RD
R70	22544102	1k ohm ±10% 1/8W RD
R71	22554102	1k ohm ±10% 1/8W Single Ended
CAPACITORS		
C01,02,07,08, 09,10,11,12,13 14,22,27,28	22448109	1μF 50WV EC

SYMBOL NO.	PART NO.	DESCRIPTION
C03,04,19,20, 25	22445100	10μF 16WV EC
C05,06,21,23, 24,25	23373104	0.1μF 50V ±20% Mylar
C15,16	22373823	0.082μF 50V ±20% Mylar
C17,18	22373153	0.015μF 50V ±20% Mylar
SEMICONDUCTORS		
TR01,02,03 04,05,06,07 08,09	31231000	TR-2SC1000-GR
DRIVER UNIT ASSEMBLY (CCT-AF-C26) **RESISTORS**		
R01,02,05,06	22544104	100k ohm ±10% 1/8W RD
R03,04	22544332	3.3k ohm ±10% 1/8W RD
R07,08	22544473	47k ohm ±10% 1/8W RD
R09,10,11,12	22544392	3.9 ohm ±10% 1/8W RD
R13,14	22570021	100 ohm ±10% 2W RN
R15,16	22544821	820 ohm ±10% 1/8W RD
R17,18	22544154	150k ohm ±10% 1/8W RD
R19,20	22544102	1k ohm ±10% 1/8W RD
R21,22	22544222	2.2k ohm ±10% 1/8W RD
R23,24	22544392	3.9k ohm ±10% 1/8W RD
R25,26,27,28	22544221	220 ohm ±10% 1/8W RD
R29,30	22500047	10 ohm ±10% 5W RW
VR01,02	22658188	300k ohm Semifixed
VR03,04	22658189	500 ohm Semifixed
CAPACITORS		
C01,02	22447479	4.7μF 35WV CE
C03,04	22447470	47μF 35WV CE
C05,06	22373224	0.22μF 50V ±20% Mylar
C07,08	22443330	33μF 10WV CE
C09,10	22362220	22pF 50V ±10% CC (SL)
C11,12	22447221	220μF 35WV CE
C13,14	22362221	220pF 50V ±10% CC (SL)
C15,16	22373103	0.01μF 50V ±10% Mylar
C17,18	22373104	0.1μF 50V ±20% Mylar
C19,20	22362330	33pF 50V ±10% CC (SL)
C21,22	22362470	47pF 50V ±10% CC (SL)
SEMICONDUCTORS		
TR01,02,03,04	31210561	2SA561-Y
TR05,06,07,08	31230983	2SC983-Y
TR09,10	31230493	2SC497-Y
TR11,12	31210497	2SA497-Y
D01,02,03,04	31193016	S3016-R
D05,06	31111555	1S1555
D07,08,09,10	31111555	1S1555

SYMBOL NO.	PART NO.	DESCRIPTION
EQ UNIT ASSEMBLY (CCT-AF-24)		
RESISTORS		
R01,02,57	22543474	470k ohm ±%5 1/8W RD
R03,04	22541222	2.2k ohm ±5% 1/8W LN
R05,06	22543223	22k ohm ±5% 1/8W RD
R07,08	22541105	1M ohm ±5% 1/8W JN
R09,10	22541184	180k ohm ±5% 1/8W LN
R11,12,54	22543471	470k ohm ±5% 1/8W RD
R13,14	22570072	270k ohm ±1% 1/8W RD
R15,16	22570069	47k ohm ±1% 1/8W RD
R17,18	22570071	18k ohm ±1% 1/8W RD
R19,20	22570070	8.2k ohm ±1% 1/8W RD
R21,22	22543473	47k ohm ±5% 1/8W RD
R23,24	22543333	33k ohm ±5% 1/8W RD
R25,26	22547562	5.6k ohm ±5% 1/2W RD
R27,28	22543102	1k ohm ±5% 1/8W RD
R29,30,39,40	22543105	1M ohm ±5% 1/8W RD
R31,32,41,42	22541104	100k ohm ±5% 1/8W LN
R33,34	22541333	33k ohm ±5% 1/8W LN
R35,36	22543683	68k ohm ±5% 1/8W RD
R37,38	22543224	220k ohm ±5% 1/8W RD
R43,56	22543822	8.2k ohm ±5% 1/8W RD
R44,58	22543332	3.3k ohm ±5% 1/8W RD
R45	22543225	2.2M ohm ±5% 1/8W RD
R46	22543105	1M ohm ±5% 1/8W RD
R47	22543473	47k ohm ±5% 1/8W RD
R48	22543563	56k ohm ±5% 1/8W RD
R49	22543153	15k ohm ±5% 1/8W RD
R50,51,55,60	22543682	6.8k ohm ±5% 1/8W RD
R52	22543122	1.2k ohm ±5% 1/8W RD
R53	22543272	2.7k ohm ±5% 1/8W RD
R59	22543392	3.9k ohm ±5% 1/8W RD
R61,62	22543104	100k ohm ±5% 1/8W RD
CAPACITORS		
C01,02	22401026	4.7μF 35V CS
C03,04	22447101	100μF 35V
C05,06	22362470	47 pF 50V ±10% CC
C07,08,25,26	22343221	220 pF ±20% CK
C09,10	22440039	47μF 50V KU
C11,12	22370031	0.01μF 50V ±2% Mylar
C13,14	22380019	2400 pF 50V
C15,16	22380018	470 pF 50V
C17,28	22445101	100μF 16V
C19,20	22440038	1μF 50V KU
C21,22	22371223	0.022μF 50V ±5% Mylar
C23,24	22371332	0.0033μF 50V ±5% Mylar
C27,28	22447100	10μF 35V
C29,30	22401003	1μF 35V CS
C31,32	22440047	4.7μF 35V
C33	22445330	33μF 16V
C34	22445100	10μF 16V
C35	22401025	0.33μF 35V CS
C37	22448470	47μF 50V
SEMICONDUCTORS		
TR01,02,03, 04,07,08,11	31210493	2SA493-GR
TR05,06	31230983	2SC983-Y
TR09,10	31231000	2SC1000-GR
BTL SW UNIT ASSEMBLY (CCT-SW-C15)		
RESISTORS		
R01,02	22543154	150k ohm ±5% 1/8W RD
R03,04,07	225 3562	5.6k ohm ±5% 1/8W RD
R05,06	22543683	68k ohm ±5% 1/8W RD
R09,10,11,12,13	22543473	47k ohm ±5% 1/8W RD
R08	22553562	5.6k ohm ±5% 1/8W Single Ended
CAPACITORS		
C01,02,03,04 05,06	22448109	1μF 50V
C07,08	22362470	47 p ±10% 50V CC
SEMICONDUCTORS		
TR01,02	31231000	2SC-1000
S01	22146660	Push Switch
SPEAKER SW UNIT ASSEMBLY (CCT-SW-C14)		
RESISTORS		
R01,03,04	22543332	3.3k ohm ±5% 1/8W RD
R02	22553332	3.3k ohm ±5% 1/8W Single Ended
VR01,02,03,04	22658186	1k ohm Semifixed
SEMICONDUCTORS		
D01,02,03,04	31120060	1N60
D05,06,07,08	31111555	1S1555
S01	22146657	Push Switch
MODE SW UNIT ASSEMBLY (CCT-SW-C13)		
RESISTORS		
R01,02,03,04	22543472	4.7k ohm ±5% 1/8W RD
R05,06,07,08	22543103	10k ohm ±5% 1/8W RD
R09,10,11,12	22543104	100k ohm ±5% 1/8W RD

SYMBOL NO.	PART NO.	DESCRIPTION
SEMICONDUCTORS		
S01	22146661	Push Switch
SELECTOR UNIT ASSEM BLY (CCT-SW-c12)		
SEMICONDUCTORS		
S01	22146658	Push Switch
ACCESSORY UNIT ASSEMBLY (CCT-FILT-C02)		
RESISTORS		
R01,02,03,04, 05,06,07,08	22543473	47k ohm ±5% 1/8W RD
R09,10,11,12, 26	22543223	22k ohm ±5% 1/8W RD
R13,14,15,16	22543100	10k ohm ±5% 1/8W RD
R17,18,29,20	22543474	470k ohm ±5% 1/8W RD
R21,22,23,24	22543273	27k ohm ±5% 1/8W RD
R25,27,28	22553223	22k ohm ±5% 1/8W Single Ended
CAPACITORS		
C01,02,03,04 05,06,07,08	22448229	2.2μF 50WV
C09,10,11,12	22447479	4.7μF 35WV
C13,14,15,16	22373823	0.082μF ±20% 50WV
17,18,19,20 21,22,23,24	22373823	0.01μF ±20% 50WV
C25,26,27,28	22362151	150p ±10% 50WV
SEMICONDUCTORS		
S01	22146659	Push Switch
US-PIN UNIT ASSEMBLY (CCT-PIN-C01)		
RESISTORS		
R01,02,03,04	22543563	56k ohm ±5% 1/8W RD
CAPACITORS		
C01	22445470	47μF 16V
COIL UNIT ASSEMBLY (CCT-FILT-C03)		
RESISTORS		
R01,02	22563100	10 ohm ±10% 1/2W RD
SEMICONDUCTOR		
L01,02	22210107	1.27 mH

SYMBOL NO.	PART NO.	DESCRIPTION
ELECTRICAL PARTS		
	22213850	TRANS-PT8015
	22104223	METER-LEVEL
	22113211	LAMP.-METER
	22116086	SOCKET-RT
S001	2214599	LEVER Switch
CB001,	22148605	CIRKIT BREAKER
CB002,003,	22148605	CIRKIT BREAKER
CB004,005	22160016	PC, CONNECTOR-14
	22162258	Terminal (Earth)
	22162264	Terminal (Speaker)
	22162290	Terminal
	22162305	Terminal (1P)
	22162306	Terminal (4P)
	22162307	Terminal (5P)
J001	22163443	Jack US 4P
J002	22163446	Jack US4P-S
J003	22163444	Jack US6P
J004	22163437	Jack Mic
J005	22164392	PLUG-2P-B
J006,007	22163155	Jack Headphon
J008,009		
J010	22167145	Voltage Selector
	22167420	Ac Concent
	22184158	Wire Clip
R001	22544101	100 ohm ±10% 1/8W RD
R002,003, 004,005	22554104	100k ohm ±10% 1/8W Single Ended
R006,007 008,009	22546333	33k ohm ±10% 1/4W RD
R010,011,012 013,014,015, 016	22500048	0.5 ohm ±10% 3W Cement Resistor
R017,018,019 020	22500047	220 ohm ±10% 2W M.Film Resistor
VR001	22650424	250k ohm B Variable Resistor (Main)
VR002	22625400	50k ohm A Variable Resistor (Mic)
	22142677	PC Poard (Connector)
C001	22321201	0.022μF±20% 250V Film Capacitor
C002,003	22430032	6800μF 50WV Electric Capacitor
TR001,002 003,004	31230793	2SC793-BL
TR005,006 007,008	31210663,	2SA663-BL
TR009,010 011,012	31230496	2SC496